THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

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NEW TELEPHONES.

IT is somewhat remarkable that in spite of the enormous number of experiments which have been carried out, surprisingly little progress has been made towards obtaining a perfect telephone. Progress *has* been made, undoubtedly, but it is out of all proportion to the amount of energy which has been expended on the subject. Theoretically, a telephone to speak out as loud as desired is as apparently possible as the possibility of making an extremely weak telegraphic current, relay an equally strong current with certainty. The weak received telephonic currents should apparently be able to unlock corresponding currents of a much greater intensity, or the action of the transmitter should be able to control currents sufficiently powerful to produce a giant's voice, yet actually nothing like this result has been accomplished. The so-called loud-speaking telephones indeed approach the threshold of the theoretical possibility, but they seem unable to go further.

Loud speaking, it is true, is not required, or indeed desirable for general use, but clearness of utterance is, and if the general problem be solved, it is always possible to tone down and shape to any particular requirement, just as a Koh-i-noor can be shaped down from a large shapeless mass, though we cannot produce it from a less bulk.

We continually hear of new forms of telephones which are stated to give wonderful results, but we must confess that our experience of such inventions has been anything but hopeful, as they almost invariably fail to give the glowing results which their inventors claim for them, except under extraordinary conditions.

It is rarely that we hear of distinct departures from the old lines in inventions: inventors are disinclined to attempt to obtain effects from unpromising materials, and a few unsuccessful trials usually drives them back into the old groove, so that they content themselves with improving what they know will work rather than go groping in the dark after what may after all prove to be an idle dream.

Although Dr. Herz's telephone, which was described in our last issue, was foreshadowed to some extent, yet the results obtained are somewhat surprising, and are likely to prove of considerable value, inasmuch as they prove the practicability of obtaining telephonic communication by other means than those which are at present considered to be the exclusive property of one or two individuals. The statement that an efficient microphonic transmitter can be formed from other materials than carbon is important if the employment of the latter material is covered by a patent, which point we understand is to be contested. The use of a receiver which is not magnetic is also an important feature, as we believe such a receiver is not the subject of an existing patent, at least in this country. If, therefore, Dr. Herz's discoveries promise as well as they appear to do, they may inaugurate a new era in telephony.

It is claimed by the inventor that his system avoids that bugbear of telephony, viz., "induction;" this we are inclined to think is only partially the case, and the theory that it should effect the cure because there is no circuit, is entirely fallacious and contrary to theory.

The effect of one current flowing in the neighbourhood of another is to disturb the equilibrium at the moment when the current flows or ceases to flow. If the wire in which the equilibrium has a tendency to be upset, be disconnected at both ends, then the conditions for a variation cease to exist; but insert a condenser at one or both ends, and then a disturbance outside the wire will tend to cause a current to flow in the wire, which current will flow into the condenser until the potential in the latter reaches a certain point dependent upon the strength of the inducing current and the capacity of the condenser; increase the latter to infinity and we shall then obtain an induced current as strong as we should get if the wire were earthed at both ends, although in the one case there is disconnection or no circuit and in the other a complete loop. *Steady* earth currents, it is true, are cut off, but if there is a variation in these they will, in virtue of their change, produce an induced effect, exactly as will the telephonic currents.

ON A SIMPLE FORM OF SELENIUM CELL AND EXPERIMENTS THEREWITH.*

By PROFESSOR JAMES BLYTH.

THE recent remarkable discovery of the photophone by Professor Graham Bell has turned the attention of experimenters to a peculiar property of selenium first discovered by Mr. Willoughby Smith. That

* Read before the Royal Society of Edinburgh.

property is that, in the crystalline state, its electrical resistance varies under the influence of light.

Since the specific resistance of selenium is very high, it is obviously necessary, in order to make a selenium cell as sensitive as possible, to obtain a long, thin layer of it between two parallel conductors which serve as electrodes, and so to arrange this layer that as great a length of it as possible can be brought under the influence of light at one time. It struck me that a good way of fulfilling these conditions would be by making the cell in the form of two interlacing combs, and by placing the selenium between the teeth. For this purpose I obtained two similar brass pocket combs, and having knocked out each alternate tooth from both, I screwed them down to a piece of dry wood with the teeth interlacing, but taking care not to let them touch in any part. Copper wires soldered to the back of each comb formed the electrodes.

Having heated up the combs in front of a bright red fire to the melting-point of selenium, the selenium was carefully rubbed in between the teeth, and the cell annealed in an air bath whose temperature could be watched by a thermometer. During the whole annealing process the cell was joined up in the ordinary way with a resistance-box and Wheatstone bridge, and the variation of its resistance carefully watched. The resistance was found to decrease as the temperature rose, till it reached a minimum, and then began to increase again. At that point the heat was withdrawn, and the cell allowed gradually to cool. The selenium then presented a crystalline appearance.

My first supply of selenium falling short, I ordered a second, and made a cell with it precisely similar to the former. This cell, however, presented some perplexing peculiarities, inasmuch as although its resistance came down very low, to something like 170 ohms, I found it almost entirely insensitive to the influence of light. This is, I have no doubt, due to some impurity in the selenium, which I hope to detect by a chemical analysis which is now being made for me.

I have also made the comb cell in a cylindrical form by bending the comb round a glass tube and soldering the edges together. When this form of cell was placed round a tube containing a singing flame, and joined up in circuit with a telephone and a battery of twenty Grove's cells, I was able to hear the singing of the flame distinctly reproduced in the telephone.

Having obtained a cell which was sensitive to a singing flame, it was an easy step to find if it would be equally sensitive to the variations produced in the flame of a Koenig's capsule by speaking against the membrane. This I found to be the case, the articulation being produced very clearly. This result is of great interest, as it shows the remarkable rapidity with which the resistance of the selenium must vary before it can reproduce articulation by the mere variation of the light from a small gas jet. The same result has also been recently shown by Mr. Jamieson by means of his highly sensitive and ingenious form of cell.

I have also arranged the comb cell in what may be called the radial form. This form is made by fixing a circular disc of brass to the end of a cylindrical piece of dry mahogany. Twenty-four saw cuts are then made right down through the centre of the disc and equally inclined to each other. The brass disc is thus cut up into twenty-four equal-sized sectors, and the selenium is placed in the narrow slits between them. The first, third, fifth, &c., sectors are connected by a wire which serves as one electrode, and the second, fourth, sixth, &c., by another wire serving for the other electrode.

Being in great measure brought to a standstill in my experiments from the want of good selenium, I began to think if something could not be got which would serve as a substitute; and the first thing I determined to try was amorphous phosphorus. For this purpose I packed the slits of a radial cell with the phosphorus, and proceeded to test its resistance by the bridge in the ordinary way. I was surprised to find, however, that I could not obtain a balance. This at once led me to suspect that the cell itself was acting as a voltaic battery; and on joining it up directly with the galvanometer, I at once saw that this was the case from the strong deflection of the spot of light. I also found that the deflection varied by pressing the phosphorus, and this led me to suppose that amorphous phosphorus might be made to play the part both of battery and loose contact as a transmitter in a telephone circuit.

I immediately made such a transmitter, which consisted simply of a shallow box with a brass disc at the bottom, to which one electrode was attached, and a lid made of very thin sheet brass, to which the other electrode was attached. The phosphorus was placed between the two brass pieces, and a mouthpiece was arranged, by means of which the voice could be directed against the thin brass lid. With this transmitter in circuit with a telephone, and without any battery but itself, I could hear articulation perfectly transmitted. With two bichromate cells in the circuit the articulation was surprisingly loud and clear.

THE HISTORY OF SELENIUM AND ITS ACTION IN PROFESSOR GRAHAM BELL'S PHOTOPHONE, WITH DESCRIPTION OF NEW FORM.*

By A. JAMIESON, C.E.

THE discovery of the non-metallic element selenium (symbol, Se; atomic weight, 79·0; vapour density, 79·0; specific gravity, 4·5, varies according to condition) is due to Berzelius, who observed it in the deposit of sulphuric acid chambers at Gripsholm, in Sweden, in the year 1817, when attempting to obtain a new source of supply of the rare metalloid, Tellurium. The name is derived from Σελήνη, the moon, on account of its analogy with the element, Tellurium (*tellus*, the earth), which had been discovered previously and so named by Klapworth in 1798.

Selenium is widely distributed, but only obtainable in small quantities from iron and copper pyrites, the smoke from the furnaces of silver works, the deposit in leaden chambers at sulphuric acid works;

*Extracts from paper read before the Glasgow Philosophical Society.

and it has also been found in metallic copper of commerce.

The present price of selenium ranges from 10s. to £1 10s. per ounce, and the author has been greatly indebted to his friend, Mr. Robert Tattock of this society, for procuring the specimen exhibited, as well as the other pieces with which he has experimented in making sensitive selenium cells.

Selenium appears in two chemical allotropic modifications; the one soluble, and the other insoluble, in disulphide of carbon ($C S_2$). That soluble in disulphide of carbon has been called "red selenium," "amorphous selenium," and "glassy selenium." It is a bad conductor of heat and a non-conductor of electricity. That *insoluble* in disulphide of carbon (and which is the element of interest at present) has been called "black selenium," "granular selenium," "metallic selenium," and "crystalline selenium."

Mr. Willoughby Smith, Electrician in Chief to the Telegraph Construction and Maintenance Company, was the first to bring prominently before the scientific world the curious electrical properties of selenium. He was the inaugurator of an important system of electrical testing and signalling in connection with the laying of long telegraph cables, in which it was necessary to employ high resistances of many megohms; and as a single megohm coil well made of platinum silver wire costs about £80, his attention was drawn to the high resistance which selenium offered to the passage of electric currents, and he found that he could produce equally reliable results with this material, at a price of 30s.

Selenium was thus first introduced as of practical use in the important process of the laying of submarine cables in 1873-74 (and not 1866 as has been reported), and has been found so well adapted to the purposes required, that the Telegraph Construction and Maintenance Company never fit out an expedition of importance without including resistance boxes of this curious and subtle material.

Mr. Willoughby Smith soon recognised (with the assistance of Mr. May) the peculiar effect which light and heat had upon the electrical conductivity of selenium; and he brought before the Society of Telegraph Engineers several important communications (February 4th, 1873; March 8th, 1876; November 28th, 1877), wherein he described a number of experiments which he had carried out relating to the matter.*

Dr. Werner Siemens of Berlin, Dr. C. W. Siemens of London, Professor W. G. Adams of London, Lieut. Sale, R.E., the Earl of Rosse, and other electricians, took up the matter at this point, and proved several curious facts.

It remained, however, for Professor Graham Bell and Mr. Sumner Tainter to discover last summer the possibility of the transmission of musical notes and speech by means of an undulatory beam of light projected from a disc (vibrating under the action of the voice) upon a sensitive selenium cell, the latter being in circuit with an electric battery and telephone. Following up Professor Bell's discovery, the author found out that musical sounds and speech can be transmitted by a *gas flame (governed by the voice) acting on selenium.*

Previous to Professor Bell's experiments, the following had been elicited regarding the action of light and heat upon "granular selenium," viz., that it exhibits three different electrical properties, according to the temperature and mode of treatment by which it is prepared.

I. If prepared at a temperature of *not* above 100° C. it is a very bad conductor of electricity, and does not acquire conducting properties on exposure to light or a short exposure to moderate heat rays.

II. If melted quickly and raised to 210° C. and cooled quickly, it conducts much better than No. 1, is poorly sensitive to light, and its conductivity increases rapidly upon raising its temperature. It however still retains metallic appearance of No. 1, but to a lesser degree.

III. If melted and pressed between the wires of a gridiron of fine brass or copper wires, then cooled, and afterwards carefully annealed, by being raised to various temperatures, between 120° C. and 210° C., and kept at the latter temperature for some time, and then very gradually cooled, the glossy metallic appearance becomes changed to a dull slate or lead colour; the conductivity is generally very good, say from 300 to 3,000 ohms at 100° C. in the dark. Selenium thus prepared is very sensitive to light, and fairly so to an equivalent amount of heat rays. Plan No. III. is the best for securing a sensitive cell; but as selenium varies so much in quality, *no hard and fast rule can be laid down for manipulating it.*

Some experimenters affirm that the conductivity of selenium decreases with rising temperature, and, therefore, that it behaves like a metal; but the author has in every case found with his cells that an increase of temperature was accompanied by an increase of conductivity, so long as the temperature did not exceed 213° C. (see Table I.), or, in other words, that selenium invariably behaves like a dielectric at temperatures below 213° C.

The conducting power of a selenium cell is effected by time on exposure to light; that is to say, a momentary exposure will reduce the resistance, and a continued exposure will still further do so; but it takes a much longer time to regain its normal resistance on being confined to darkness. For example, if exposed for a couple of seconds to the light from an ordinary gas jet, at two inches distance, it will take several minutes, at least, to completely regain its original resistance on return to darkness. Daylight and direct sun-rays have a much greater effect in reducing the resistance than gas or lamp light. Earl Rosse and Dr. Werner Siemens showed that the variation in resistance of selenium is proportional to the square root of the intensity of illumination. The author has found that a selenium cell increases in resistance with age, as may be seen by reference to tests of cell No. 3 (Table II.), which is contrary to Professor W. G. Adams' report (Vol. vi. p. 442, "Soc. Tel. Engs. Journal.")

Granular, or insoluble selenium, has no definite melting-point, as it softens gradually like sealing wax upon the application of heat, whereas the red, or amorphous, form has a constant melting-point at 217° C, and both forms pass off in a dark reddish

* It was at Aden in January, 1880, on completion of the laying of the Eastern and South African Cable by the Telegraph Construction and Maintenance Company, that the author first thought of a plan for automatic translation on long submarine telegraph cables by using selenium cells. He there saw Mr. Willoughby Smith's high selenium resistances, read his and other papers on the subject, and afterwards at Malta drew out several schemes for carrying it into operation. He, however, failed to carry it into execution, but is again trying it, believing it to be practicable and worth accomplishing.

brown vapour, at somewhere below 700° C. This vapour can be condensed, either in the form of scarlet flowers of selenium or dark shining drops. Care must therefore be taken in dealing with this expensive material not to heat it too highly (say above 300° C.). The author mentions this fact, because he unwittingly allowed a piece under treatment to disappear into vapour, while attempting to melt and smooth it down upon a cell with a red hot iron. He found, as far as the requirements for melting selenium are concerned, in the making of "sensitive cells," that the temperature need never exceed 215° C., and that the change from the glassy, metallic, high resistance condition, to that of the crystalline, or low resistance state, may even take place at as low a temperature as 120° C., and sometimes lower.

Mr. Willoughby Smith and others infer from their experiments that the effect of light upon selenium is, so far, independent of its accompanying heat rays, while some say that the heat rays are at the bottom of the whole matter. Upon this point there is considerable divergence of opinion.

TABLE I.

Table showing times, temperatures, and corresponding resistances, with remarks, when annealing circular form of cell No. 1 in hot air bath, joined up in Wheatstone bridge without telephone in circuit.

January 14th, 1881.

Time in Air Bath.	Temp. C.	Res. in ohms.	Remarks.
12.45 p.m. H. M.	10° rising		6 Leclanché cells used, cell put in cold at 10° C. after scraping off surplus selenium.
0 5	130°	4000	
0 10	140°	2300	Res. falling with increasing temperature, cell in perfect darkness whole time, behaving like a dielectric.
0 35	160°	1700	
0 45	185°	800	
0 48	195°	650	
0 50	200°	440	
0 55	210°	300	
0 56	210°	290	
	213°	change	At 213° C. the res. changed from decreasing, and rapidly rose with a few degrees of increasing tem., behaving like a metal
0 58	215°	350	
1.45 p.m. 1 0	218°	600	
—	—	—	
1 35	140°	295	Lowered tem., and cell fell again in res. Left cell to cool very gradually, taking various readings, res. rising again.
2 45	125°	350	
2 55	110°	360	
3 15	100°	360	
3 18	90°	340?	Cell removed, and allowed to cool, afterwards tried with singing flame and distinctly heard the note in telephone.

TABLE II.

History of No. 3 Flat Cell. Made up December 27th (3 p.m.), 1880. Showing increasing resistance with age.

Date.	Temp. C.	Resistance in ohms. In dark.	In light, about 2 in. from gas.	Differ. in ohms. between dark and light.
1880, Dec. 27	About 100° C.	530	—	—
28	—	2700	1690	1010
29	About 25° C.	3180	1620	1560
,,	After several exposures to light.	2250	1120	1130
—	—	—	—	—
1881, Jan. 10	—	3300	2350	950
14	Nearly freezing.	6700	2900	3800
15	About 5° C.	6900	3200	3700
19	After handling and exposure.	6200	3900	2300
,,	At lecture, warm room, about 20° C.	5740	2340	3400

The above cell answers admirably, and truthfully reproduces singing and speech.

Tests, since lecture, of the above cell :—

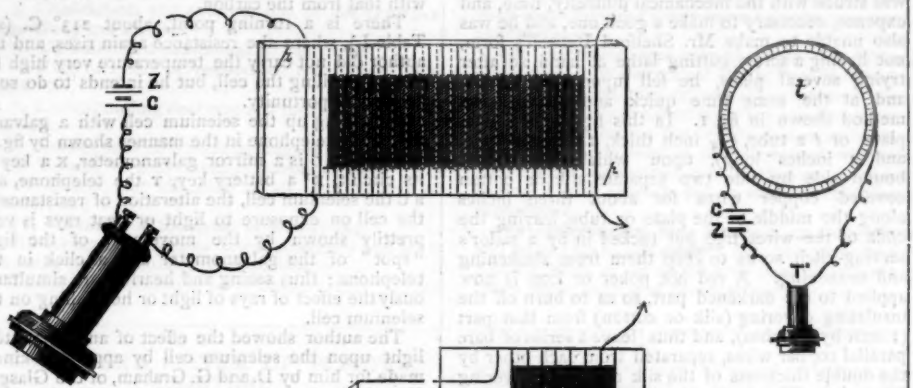
Date.	Temp. C.	Resistance in ohms. In dark.	In light, about 2 in. from gas.	Differ. in ohms. between dark and light.
1881.				
Jan. 22	After long confinement to darkness, 10° C.	(Z. & C.) 8500	3440	5060
24	9·0°	,, 8500	3040	5460
25	9·5°	,, 8500	3100	5400
26	6·0°	,, 9900	3940	5960
28	9·3°	,, 8300	4940†	3360
31	10·0°	,, 9740	4270	5470
Feb. 3	12·0°	,, 9540	3500	6040
16	11·0°	,, 10000	4700	5300
17	11·0° *	,, 9730	4370	5360
21	10·0°	,, 11100	5170	5930

Mr. Jamieson is still testing this cell, and although the resistance is gradually rising with age, yet he cannot perceive as yet any diminution in its power of reproducing singing and speech, in fact, it seems to have more resilience than when at a lower resistance, just like a keen stiff spring in comparison with a wabbling soft one; and he does not think Professor Sylvanus Thompson will find much benefit in trying to reduce the resistance of Mr. Shelford Bidwell's cells very much by increasing their area beyond certain limits.

While trying to construct a cell according to the

* Previously exposed. † Very damp day.

FIG. 1.



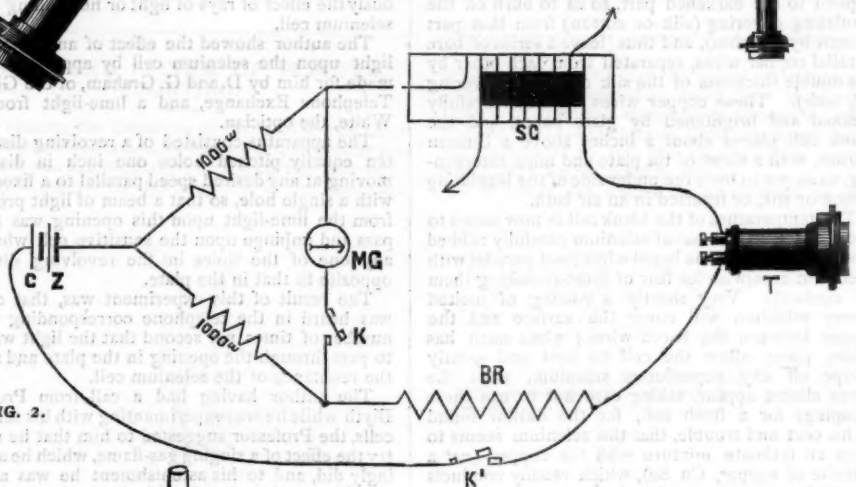
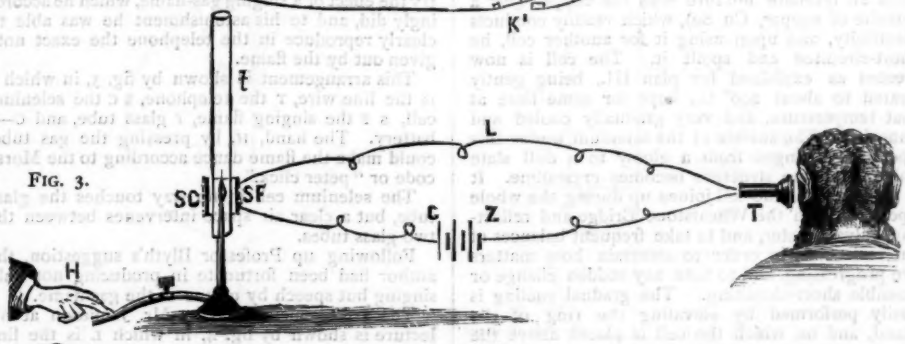


FIG. 2.

FIG. 3.



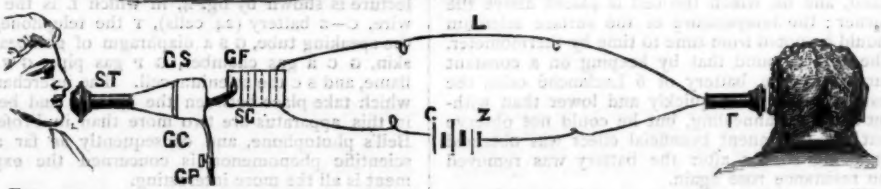


FIG. 4.

directions laid down by Professor Bell, the author was struck with the mechanical difficulty, time, and expense, necessary to make a good one, and he was also unable to make Mr. Shelford Bidwell's form, not having a screw cutting lathe at hand, so after trying several plans, he fell upon the simple, and at the same time quick and inexpensive, method shown in fig. 1. In this fig., *p* is a glass plate, or *t* a tube, ($\frac{1}{16}$ inch thick, $1\frac{1}{2}$ inches wide, and 4 inches long), upon which are tightly bound side by side two separate silk or cotton covered copper wires for about three inches along the middle of the plate or tube, leaving the ends of the wires free but tucked in by a sailor's serving-hitch, so as to keep them from slackening and unreeving. A red hot poker or iron is now applied to the darkened part, so as to burn off the insulating covering (silk or cotton) from that part (1 inch by 2 inches), and thus leave a series of bare parallel copper wires, separated from each other by the double thickness of the silk or cotton covering ($\frac{1}{50}$ inch). These copper wires are now carefully cleaned and brightened by glass paper, and the blank cell placed about 2 inches above a Bunsen burner, with a sheet of tin plate and mica intervening, so as not to burn the under side of the insulating cotton or silk, or inserted in an air bath.

The temperature of the blank cell is now raised to about 215° C., and a bar of selenium carefully rubbed over the surface of the bared wires (and parallel with them, not crosswise for fear of short-circuiting them by contact). Very shortly a coating of melted glossy selenium will cover the surface and the spaces between the bared wires; when such has taken place, allow the cell to cool and gently scrape off any superfluous selenium, until the wires almost appear, taking care not to use these scrapings for a fresh cell, for the author found to his cost and trouble, that the selenium seems to form an intimate mixture with the copper (*not* a selenite of copper, Cu Se), which readily conducts electricity, and upon using it for another cell, he short-circuited and spoilt it. The cell is now treated as explained for plan III., being gently heated to about 200° C., kept for some time at that temperature, and very gradually cooled and annealed. The surface of the selenium under this operation changes from a glossy to a dull slate colour, and the structure becomes crystalline. It is well to have the cell joined up during the whole operation with the Wheatstone Bridge and reflecting galvanometer, and to take frequent balances of the resistance, in order to ascertain how matters are progressing, and to note any sudden change or possible short-circuiting. The gradual cooling is easily performed by elevating the ring of the stand, and on which the cell is placed above the burner; the temperature of the surface selenium should be noted from time to time by thermometer. The author found that by keeping on a constant current from a battery of 6 Leclanché cells, the resistance fell more quickly and lower than without it during annealing, but he could not observe that any permanent beneficial effect was obtained by doing so, for after the battery was removed the resistance rose again.

With a stronger battery, 24 Leclanchés, he observed some cells polarise exactly like a fault in a submarine cable, the resistance decreasing with the current from the zinc pole and increasing with that from the carbon.

There is a turning point, about 213° C. (see Table I.), where the resistance again rises, and the author did not carry the temperature very high for fear of spoiling the cell, but he intends to do so at an early opportunity.

By joining up the selenium cell with a galvanometer and telephone in the manner shown by fig. 2, in which M G is a mirror galvanometer, K a key in its circuit, K^1 a battery key, T the telephone, and S C the selenium cell, the alteration of resistance of the cell on exposure to light or heat rays is very prettily shown by the movement of the light "spot" of the galvanometer and a click in the telephone; thus seeing and hearing are simultaneously the effect of rays of light or heat falling on the selenium cell.

The author showed the effect of an intermittent light upon the selenium cell by apparatus kindly made for him by D. and G. Graham, of the Glasgow Telephone Exchange, and a lime-light from Mr. White, the optician.

The apparatus consisted of a revolving disc, with ten equally pitched holes one inch in diameter, moving at any desired speed parallel to a fixed plate with a single hole, so that a beam of light projected from the lime-light upon this opening was free to pass and impinge upon the sensitive cell whenever any one of the holes in the revolving disc was opposite to that in the plate.

The result of this experiment was, that a note was heard in the telephone corresponding to the number of times per second that the light was free to pass through the opening in the plate and reduce the resistance of the selenium cell.

The author having had a call from Professor Blyth while he was experimenting with his selenium cells, the Professor suggested to him that he should try the effect of a singing gas-flame, which he accordingly did, and to his astonishment he was able to clearly reproduce in the telephone the exact note given out by the flame.

This arrangement is shown by fig. 3, in which L is the line wire, T the telephone, S C the selenium cell, S F the singing flame, *t* glass tube, and C—Z battery. The hand, H, by pressing the gas tube, could make the flame dance according to the Morse code or "peter click."

The selenium cell in no way touches the glass tube, but a clear air space intervenes between the two glass tubes.

Following up Professor Blyth's suggestion, the author had been fortunate in producing not only singing but speech by means of the gas-flame.

The arrangement tried by Mr. Jamieson at his lecture is shown by fig. 4, in which L is the line wire, C—Z battery (24 cells), T the telephone, S T the speaking tube, G S a diaphragm of goldbeaters' skin, G C a gas chamber, G P gas pipe, G F gas flame, and S C the selenium cell. The interchanges which take place between the speaker and hearer in this apparatus are two more than in Professor Bell's photophone, and consequently as far as a scientific phenomenon is concerned the experiment is all the more interesting.

Commencing with the operator we have—

1. Muscular movement of speaking, muscles, &c.
2. Vibration of air in speaking tube.

3. Vibration of thin diaphragm.
4. Contraction and enlargement of gas chamber regulating gas supply.
5. Up and down movement of gas-flame.
6. Rise and fall of resistance in selenium cell, with
7. Corresponding decrease and increase of battery current.
8. Consequent alteration in magnet of telephone.
9. To and fro movement of telephone disc.
10. Consequent vibration of air opposite ear of hearer, and
11. Vibration of the drum of his ear, &c.

All taking place almost instantaneously and with amazing truthfulness of reproduction.

The author concluded by remarking that had we only eyes of selenium, we should be enabled to see with many hundred times more celerity than we do at present.

The discussion was carried on by Sir William Thomson, Dr. Wallace, Prof. Blyth, Prof. McKendrie, and others, and they universally expressed themselves as greatly satisfied with the results not only shown at the lecture but by Mr. Jamieson to those who called upon him at his laboratory, where the above-mentioned gentlemen testified as to not only having heard singing but actual speech clearly reproduced.

We congratulate Mr. Jamieson on his efforts, and point out to our readers that the plans in figs. 3 and 4 seem to us to be very handy for lecture-room experiment and demonstration.

LANE FOX'S SYSTEM OF ELECTRIC LIGHTING.

THIS system, the invention of Mr. St. George Lane Fox, includes the lamp, the method of distributing the current, and the regulation of the current strength.

Fig. 1 represents the lamp. A is the luminous

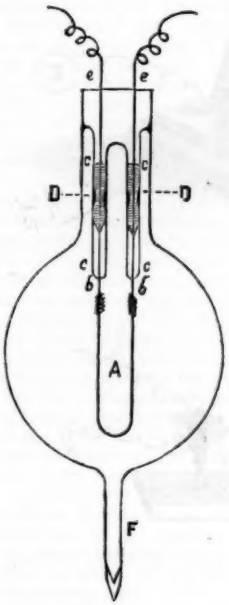


FIG. 1.

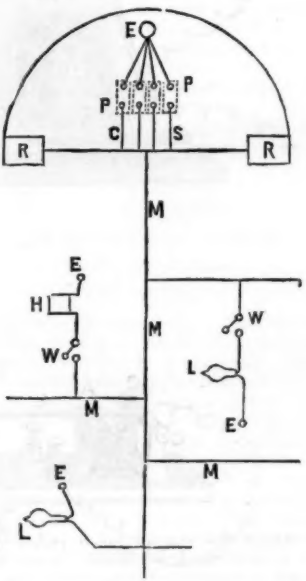


FIG. 2.

conductor or "bridge," mounted on the platinum wires, *b b*, which are fused into the glass tubes, *c c*. These tubes contain mercury, which surrounds the ends of the platinum wires. That part of the tubes, *c c*, into which the wires are fused is made of English lead glass, while the rest of the lamp, from the point, D, is made of German glass, for facility of construction. The luminous bridge, A, consists of a carbon thread of high electrical resistance. In practice, it is proposed to make them of 250 ohms resistance while in a state of incandescence; but, as will be seen immediately, their resistance can be adjusted so as to suit the electromotive force at which they are intended to work.

The lamps are ordinarily constructed so as to give a light of between 10 and 20 candles, but they can be made of any power, from 2 or 3 candles upwards; the quantity of light being directly proportional to the extent of luminous surface which the bridge exposes for radiation, and to the amount of energy expended. The temperature of the bridge is in all cases maintained as nearly as possible constant, as there is a point somewhere between the

fusing points of platinum or iridium at which, practically, the carbon filament undergoes no deterioration, but above which it is soon destroyed. This point varies with the degree to which the exhaustion of the globe is carried. With a very perfect vacuum it is possible to use a much higher temperature with safety, and so obtain a more economical light.

The ends of the bridge are thrust tightly into

FIG. 4.

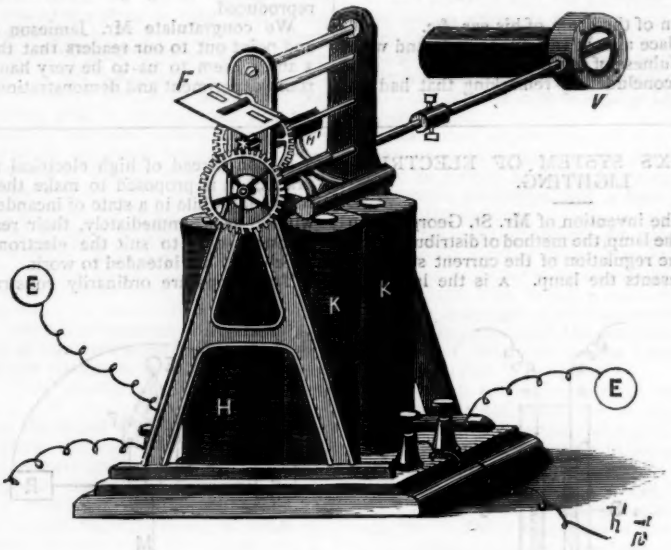


FIG. 3.

small spirals at the ends of the wires, *b b*, which are then covered with Indian ink.

The conducting wires, *e e*, dip into the mercury in the tubes, *c c*.

The lamp is attached to the exhausting pump by the tube, F.

When the vacuum is good, the current is turned on so as to raise the bridge to incandescence. The exhaustion is then continued for about two days.

The pump used in the manufacture of these lamps is new, and was devised specially for the purpose. It is very many times more rapid in its action than the Sprengel pump, and will produce a far more perfect vacuum.

The carbon filaments are prepared as follows:—A thread of flax or cotton is wound round a block of carbon or graphite of the required shape, and, having been properly secured, the whole is inclosed in a crucible and hermetically sealed; then raised to a white heat. The threads thus carbonised are then detached from the graphite block and mounted separately in suitable clips in an atmosphere of coal gas and benzole. A current is then passed through them so as to render them incandescent, when a deposit of hard gas carbon will be rapidly formed on their surface.

At first, owing to their high resistance, it is

somewhat difficult to obtain a sufficiently high electromotive force to raise the carbonised threads to a white heat. In order to overcome this difficulty, the following method has been adopted. The thread is joined up, as already described, between the poles of an electric generator giving a moderate electromotive force—very little current will pass through it, but, by making a short circuit through a large electro-magnet of low resistance, and then suddenly interrupting the short circuit, the extra current so formed will have sufficient electromotive force to momentarily raise the thread to incandescence, and a small deposit of carbon will be formed. This making and breaking of the short circuit is repeated several times, until the resistance is so far reduced as to allow a moderate electromotive force to pass sufficient current for incandescence. The deposition of carbon is then continued until the right conductivity has been attained.

The method of distributing electricity for the purpose of operating an indefinite number of lamps from a central station forms the most important part of Mr. Lane Fox's inventions and patents. By the proposed system, large conductors, which may be called electric mains, are to be laid down under the roadway, and proceed from central generating stations in a manner similar to the method now adopted for the distribution of gas. These electric mains are to be insulated by being imbedded in ozokerit or other suitable material, and are to ramify throughout a town or district to every point where a light is required.

Now these mains or branches are so connected with the electric generators at the central station that they are kept charged at a constant electromotive force, or, as it might be said, electric pressure, tending to develop currents in every direction to the "earth," and the lamps are connected at various points in multiple arc between the mains and the earth. In practice, an "earth" could be conveniently effected by means of gas or water pipes, or any uninsulated conductor forming a good electric communication with the generating station. One wire of every lamp throughout the system is connected to earth, the other wire to a switch, by which it can at pleasure be put in contact with the main. It is obvious that, whenever and wherever a circuit is thus completed a current will pass through the lamp, the strength of which will depend on the resistance of the lamp and the electromotive force of the main.

The energy expended will in all cases be inversely proportional to the resistance of a lamp, and directly proportional to the number of lamps at work. Fig. 2 represents the distribution arrangement, E represents the earth, M the main, L the lamps, W switch or electric tap.

Figs. 3 and 4 represent the regulator for maintaining a constant electromotive force in the mains. Fig. 3 is an electrometer or electro-dynamometer. It consists chiefly of an electro-magnet, H, of very high resistance, the ends of its coils being connected with the main and the earth. L is a lever pivoted at C, and in connection with the mains; h and k are contact pegs communicating by means of the wires, h^1 k^1, with the electro-magnets, H and K, fig. 4. The tension spring, T, exactly balances the attraction of the electro-magnet on the armature, A, at the normal electromotive force of the mains. It is obvious that the slightest increase or diminution of the electromotive force of the mains will bring the lever, L, in contact with one or other of the pegs, h and k, and so put into action one or other of the electro-magnets, H or K.

Should, therefore, the electromotive force fall from an increased number of lamps being put into operation, the magnet, H, will be put in action and an increased supply of steam will be allowed to pass through the throttle valve, V, to the engine working the generators, and the valve will continue to open until the normal electromotive force is re-established; the reverse action takes place when the electromotive force rises owing to a number of lamps being turned off.

By this means the power generated at the central station is made commensurate with the draught on the mains.

It is estimated that on a large scale (comparable to that of large gas works) energy could be retailed by means of the electric currents at a cost of less than a farthing a horse-power per hour, or a less cost than energy resulting from the combustion of gas, so that (says Mr. Fox) electricity could actually be used for heating more economically than gas, and without its accompanying disadvantages.

Mr. Fox states, that in lighting by "incandescence" *energy* can be used more economically than gas in the proportion of about 15 to 1, a statement which must be received with caution.

TELEGRAPHIC APPARATUS IN USE IN THE BRITISH POSTAL TELEGRAPH DEPARTMENT.

XXIX.

THE WHEATSTONE AUTOMATIC SYSTEM.

(Continued.)

THE AUTOMATIC DUPLEX.

IN general principle the Wheatstone Automatic Duplex system is similar to the Double current duplex, described in Article XI. The general arrangement of the apparatus at a "Down" station is shown by fig. 118. Each station has a "transmitter," a "receiver," a "galvanometer," a "rheostat," a "condenser," and a "duplex and single switch," besides, of course, the batteries.

If we compare fig. 118 with fig. 52 in Article XI., we shall see that the only difference between the two consists in there being a Wheatstone transmitter added, and in the relay being replaced by a Wheatstone receiver. As was explained in Article XXVI., the movement of the starting and stopping lever of the transmitter shunts the battery and "Down" line connections from the controlling mechanism of the apparatus on to the terminals connected to the double current key. In other words, the transmitter and double current key are interchangeable, and as both act in the same way the general working of the arrangement is similar to that of the ordinary double current duplex.

It will be seen that the condenser, C, is not connected directly between the terminals of the rheostat, R, but has a resistance, R_1, in its circuit. This

is done in order to retard the rate of discharge, so that its action may more nearly represent that which takes place in a long line. The actual arrangement of the condenser was explained and illustrated in Article XII.

The form of duplex and single switch shown in the figure is somewhat different from that indicated in previous articles, but it is the pattern which will be in future adopted, it having been found that the original form was liable to cause faults from bad contacts having been made. The new pattern is shown by figs. 119, 120, and 121; fig. 120 being an underneath view, and fig. 121 a side section. To terminals, A, B, *a*, *b*, *c*, and *d* (which correspond to those in the old form of switch), are connected the radial springs seen in fig. 120; these springs press against a disc with metal pieces, *m*, *n*, insulated on ebonite. The whole disc is joined to the switch handle. In the position shown (handle turned to "Duplex"), terminals B and C are connected by their respective springs resting against the brass piece, *n*. Also the springs of terminals A and *b* are similarly connected by the brass piece, *m*. Springs *a* and *d* are disconnected. If now the switch handle be turned to "Single," then the brass piece, *n*, connects springs B and *d*, and the piece, *m*, connects A and *a*, leaving springs C and *b* disconnected. The switch acts precisely in the same way in fact as the old form, that is, as regards the connections; these connections, however, are made by good rubbing contacts, and are not likely to fail.

Referring again to fig. 118, it may be pointed out that the switch of the double current key, which is of the ordinary form, is shown in the position for "sending."

Since the Wheatstone automatic instrument was first introduced various improvements and modifications have been made. Some of these modifications, which were considered improvements, have been abandoned as unnecessary; amongst these may be mentioned working with "compensated currents." It will have been seen in all the diagrams of the transmitter instrument that two terminals, R_1, R_2 (fig. 88), are provided, which are kept joined across with a strap. Now, if these terminals be disconnected, then every time the pins, p_1 or p_2, break contact with the arms, A and B, at that moment the circuit between U and D becomes broken. Now, it was pointed out that when the disc, D, became thrown over to one side or the

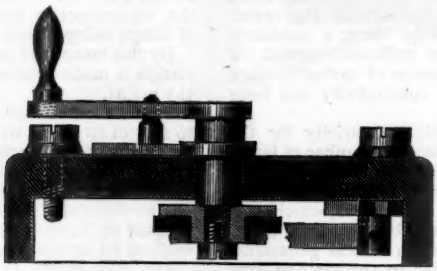


FIG. 121.

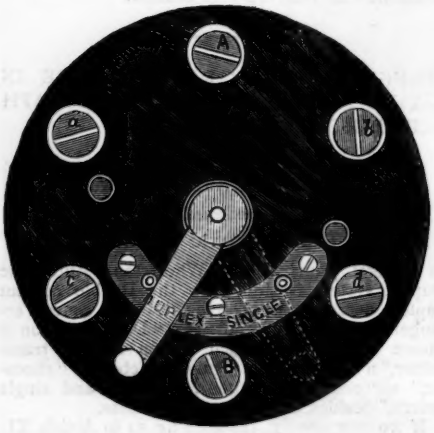


FIG. 119.

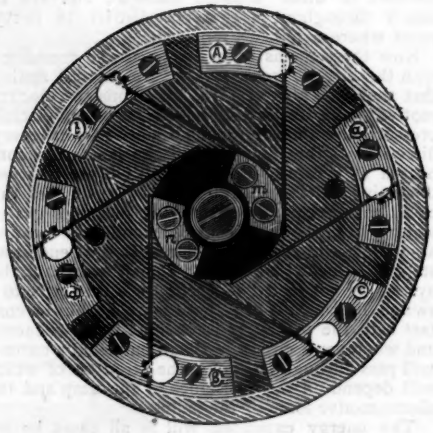


FIG. 120.

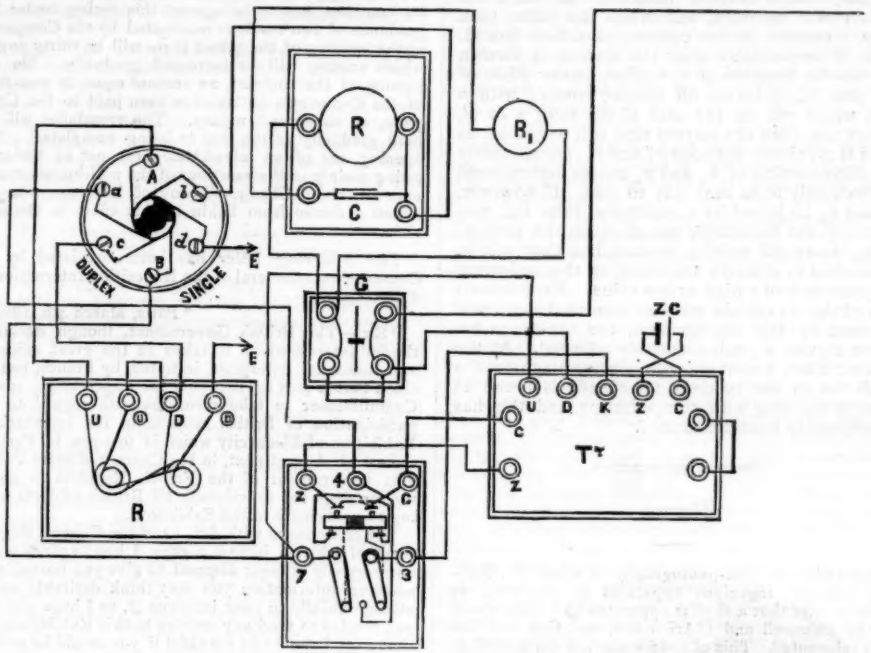


FIG. 118.

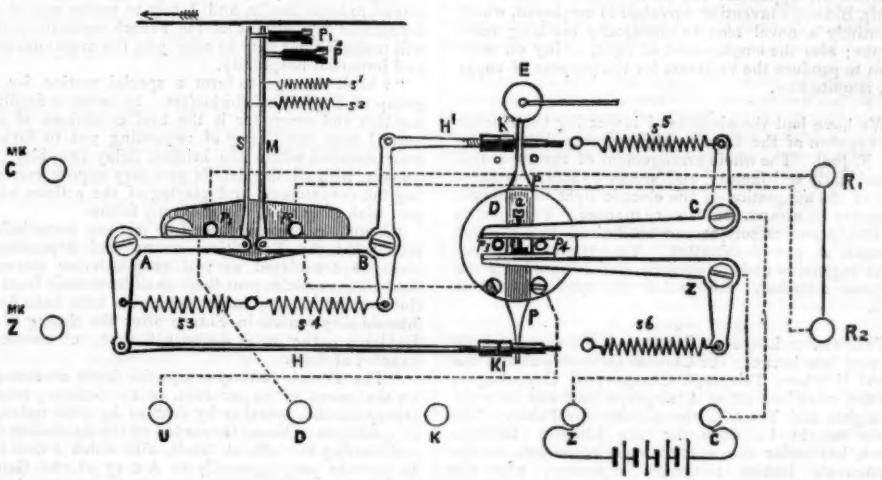


FIG. 88.

other, then a corresponding current was sent out to line, which current remained on until the motion was reversed, and when the latter took place, a current in the opposite direction flowed. Now, if immediately after the disc, D, is thrown over in one direction or the other, one or other of the pins, p_1, p_2, leaves off making contact with A or B, which will be the case if the rods, S or M, cannot rise, then the current sent will be cut off, as there is no circuit between p_1 and p_2, consequently the disconnection of R_1 and R_2 causes intermittent currents only to be sent out to line. If, however, R_1 and R_2 be joined by a resistance, then the currents will not be entirely cut off when the pins, p_1 or p_2, leave off making contact, but they will be diminished in strength according as the resistance in question is of a high or low value. Experiments proved that in certain cases an increased speed was obtained by this arrangement, the resistance between R_1 and R_2 being suitably adjusted. At the present time, however, with electro-magnets of a small size in the receiver, no benefit is found to arise by working with compensation, and this has consequently been abandoned.

Notes.

IN our article on Tele-photography in which Mr. Shelford Bidwell's ingenious apparatus is described, we seem to infer that a similar apparatus had been invented by Bakewell and D'Arlincourt, and that this had been reinvented. This of course was not our intention. What we intended to explain was, that the mechanical *idea* of copying was similar in the two cases though the *means* by which the copying was effected was entirely different. In the case of the Bakewell and D'Arlincourt apparatus the currents are *intermittent*, in Mr. Bidwell's invention *variation* is employed, which is entirely a novel idea in chemically marking telegraphs; also the employment of light, acting on selenium to produce the variation for the purpose of copying, is quite new.

WE have had the pleasure of inspecting the electric light system of the Electric Light Agency, invented by Mr. F. Joel. The whole arrangement of the apparatus is eminently satisfactory, and seems to solve the question of the adaptation of the electric light to domestic purposes in a most satisfactory manner. The light is as steady and as soft as can be desired, and a great contrast to gas illumination. The lamp fittings are most ingenious and thoroughly well adapted for the purpose intended. Altogether the system promises well.

TELEGRAPH LINES IN CHINA.—A contract has been entered into between the Chinese Government and the Great Northern Telegraph Company of Copenhagen, for the establishment of a telegraph land line between Shanghai and Tientsin, the harbour for Pekin. The work has to be done for the Chinese Government, but under the special superintendence of the Company's Danish telegraph engineers; and the Company further supplies all the materials required for the undertaking. The work has to be commenced in the month of May this year, and the line will extend over about 1,000 English miles. For the present it is the intention to establish 9 or 10 stations on the line. The contract further provides that a telegraph school, for educating Chinese for the telegraph service, in all its branches, has to be opened this spring, under the guidance of two teachers nominated by the Company; at the opening of the school there will be thirty pupils, which number will be increased gradually. On the signing of the contract, an amount equal to one-third of the Company's outlays has been paid to the Company, as an earnest money. The remainder will be paid gradually as the line is being completed. The opening out of an inland telegraph net in China is owing mainly to the exertions of the well-known statesman Li Hung Chang, Viceroy of Tientsin, who obtained a decree from Pekin to this effect in October, 1880.

THE following letter has been circulated by the Commissioner-General of the Exposition Internationale d'Electricité:—

"Paris, March 4th, 1881.

"Sir,—The British Government, though declaring the full interest which it takes in the great scientific and industrial enterprise initiated by France, has decided that it sees no necessity for appointing a special Commissioner to take measures with regard to the participation of British subjects in the International Exhibition of Electricity which is to open in Paris on the 1st of August next, in the Champs-Elysées Palace. The Government of the French Republic is nevertheless disposed to welcome all British subjects wishing to participate in the Exhibition.

"In compliance with Art. 12 of the General Regulations, of which I inclose a copy, I beg to place myself unreservedly at your disposal to give you immediately whatever information you may think desirable, and to attend officially to your interests if, as I hope you will, you resolve to send any articles to this Exhibition. In that case, I should be thankful if you would be so kind as to fill up, sign, and return to my address, the printed form of demand of admission which accompanies the copy of the General Regulations.

"You will be placed, in every respect, on the same footing as the French exhibitionists, whom I have to attend to individually, and I beg to assure you of the favourable dispositions of the French authorities, who will make it their duty to offer you the most courteous and impartial hospitality.

"I shall manage to form a special section for the group of English exhibitionists. In order to facilitate my task and secure for it the best conditions of success, I take the liberty of requesting you to forward your demand within the briefest delay possible. My answer, with all the details you may require concerning the despatching and placing of the articles which you wish to exhibit, will promptly follow.

"I am already empowered to let you know beforehand that the Exhibition rooms and dependencies shall be considered as real custom-house stores, so that all the articles sent there shall be exempt from the duties to which they might otherwise have been liable. Should they remain in France after the closing of the Exhibition, the usual duties will then, of course, be exacted of them.

"The French railway companies have consented to an abatement of 50 per cent. on the ordinary rates of transportation, whether by fast or by slow trains, for all packages or boxes forwarded to the Exhibition hall, and bearing the official labels, with which I shall have to provide you, agreeably to Art. 15 of the General Regulations. The application of these abated rates shall be made as follows: the packages or boxes shall pay the full price for transportation to Paris, but shall be taken back free of charge on presentation of a certificate signed by me, and showing that the articles have

really been exhibited. Drayage and other incidental expenses from the railway terminus in Paris to the Champs-Elysées Palace will be borne by the owners of the goods.

"A special law will secure all the extra guarantees desirable for exhibited articles made abroad but patented in France.

"Several British subjects have already applied to me concerning the Exhibition, and I am happy to hear that the Postmaster-general has been authorised by the British Government to exhibit in the name of the latter. I trust this honourable example will be followed by all the industrial electricians of the United Kingdom.

"I remain, Sir, yours respectfully,
"THE COMMISSIONER-GENERAL."

AT an ordinary meeting of the Royal Society of Edinburgh, held on February 21st, Sir William Thomson stated the results of certain experiments made by M. August Witkowski on the "Effects of strain on electric conductivity." The question to which M. Witkowski set himself to find an answer was, whether taking a metallic body—brass being the one chosen in his experiments—and submitting it to tension so as to elongate it in one direction and condense it in the opposite direction, the conductivity of the metal would be equal in all directions; or, if not, what would be its variation. The answer he had found to the question was that the conductivity was greater in the line of condensation and less in the direction of extension. He had also accurately measured the results obtained. Sir William next explained a communication of his own, "On the effect of moistening with water the opposed metallic surfaces in the Volta condenser, and of substituting a water arc for a metallic arc in the determining contact." The experiments, the results of which were given in the communication, were, he said, inspired by the attempt to explain away Volta's fundamental experiment by suggesting that the result might be due to the presence of moisture between the zinc and copper plates. Now the result of his experiment was simply the very opposite of what that suggestion seemed to imply, for the effect of the substitution of a water arc for a metallic arc in the determination of the contact was as near as might be electrically null.

OWING to the frequent interruptions which have occurred recently to telegraphic communications between Shetland and the mainland, a numerously-signed petition from the inhabitants of Lerwick has been presented to the Post-Office authorities, praying them to grant direct communication with the mainland.

UNITED TELEPHONE COMPANY, LIMITED, *v.* D. and G. GRAHAM, GLASGOW.—In this process, which came before the Court of Session, Edinburgh, on February 16th, the United Telephone Company, Limited, ask the Court to interdict the respondents, who are telegraph engineers and contractors, from infringing certain letters-patent obtained by Edison and Crossley for the manufacture of telephones. The respondents say that the instruments used by them are not a contravention of the complainers' letters-patent, and they say also that the specification in the letters-patent is faulty, and does not distinguish between what was old and new at their date and what is claimed as new; and that the invention claimed by the complainers is not new, and is not useful, advantageous, or beneficial to the public. They further explain that the telephones used by them are all made by and purchased from the Gower-Bell Telephone Company, Limited, between whom and the complainers an action raising this very question is now pending in the High Court of Chancery, and they (the respondents) therefore ask that this case should be sisted pending the issue of the other case. The Lord Ordinary, after hearing counsel, refused interim interdict, but passed the note to try the question raised, and ordered the respondents to keep count of all instruments sold, used, or let for hire by them pending the decision of the case.

EXPERIMENTAL RESEARCHES ON MAGNETIC COERCITIVE POWER.—H. Külp.—If very short rods of 10·50 mm. in length and 8 mm. in thickness are subjected to the action of the current in a spiral coil and the current is suddenly interrupted there appears a reversal of the magnetisation, especially if the rods are very hard and the magnetising power feeble.—*Wiedemann's Beiblätter.*

NEW EARTH-COMMUNICATION FOR ELECTRIC TELEGRAPHS AND LIGHTNING-CONDUCTORS.—J. Grüner's Patent.—An essential condition of every electric conduction is the presence of a perfect connection with the ground, in order to facilitate as much as possible the passage of the current into the earth. This condition has been hitherto realised only by the costly expedient of copper plates, and even then only partially, because such a plate a few days after it has been laid in the earth becomes oxidised in many places, and with this increasing oxidation its conductive power sinks down to a certain limit. But this limit is not always constant and involves a continued variation in the current. If iron plates are employed the above evils are still more strongly and speedily manifested, and various perturbing phenomena are produced, especially if the nature of the soil is unfavourable and powerful constant currents are employed. The cause of these irregularities is generally sought in the various kinds of apparatus or in the batteries, though in most cases it is due to an imperfect earth-connection. J. von Grüner, telegraphic engineer to the Vorarlberg Railway, has devised an unoxidisable earth-connection, which is at once cheap, permanent, and possessed of great conductive power. It is also well adapted for the earth-connections of lightning-conductors.—*Oesterreichische-Ungarische Post.*

BEHAVIOUR OF NON-CONDUCTORS.—By M. Baille.—The author shows by means of the replenisher that insulators which have been heavily charged by contact with an electrified body are never quite discharged by contact with a conductor. The final residuum is always constant for one and the same initial potential.—*Wiedemann's Beiblätter.*

ELECTRIC RESISTANCE OF GLASS.—According to experiments conducted at the Imperial College of Engineering at Tokio, Japan, by the professor of telegraphy, the variation of the electric resistance of glass is slower when the glass is cooling than when it is being heated, and the resistance of a piece of glass can be considerably increased by raising it slowly to a high temperature and then cooling it slowly.—*Il Progresso.*

ON THE MAGNETISABILITY OF IRON AT HIGH TEMPERATURES.—By A. WASZMUTH.—A bar 222 cm. in length, and 2·6 mm. in thickness after ignition, was magnetised by currents of different strength in a coil 260 mm. in length, in which the magnetising power did not vary more than 4 per cent. from the middle to the end of the bar. Its momentum, after compensating the action of the coil by a second coil, was read off in a mirror-compass. The bar was then heated from 20° to 146° C. by means of a current of hot oil. After the

temporary magnetisation, the magnetising current was gradually reduced to null by the introduction of greater and greater resistances in order to measure the permanent magnetism, and was then demagnetised by means of weaker alternating currents. The author cites the following results, which were confirmed by experiments with three other rods. With smaller magnetising powers the bar has at higher temperatures a greater magnetisability, the turning-point occurs for much smaller magnetising powers, and the maximum for a change of temperature of 118° C. is smaller by about 3 per cent. The ratio of the maximum to the abscissa of the turning-point is always greater. If the curves of magnetisation at the temperatures employed, $t = 20$ and $t^1 = 130$—$146°$, are determined, taking the momenta as abscissæ and the magnetising functions as ordinates, the abscissa of the average point is about three-quarters of the maximum for the time being. On repeated heating and slowly cooling, the curves for magnetisation at low temperatures move upwards and at high temperatures downwards, so that they approximate up to a certain limit.—*Wiener Berichte.*

INFLUENCE OF TEMPERATURE ON THE DISTRIBUTION OF MAGNETISM IN A PERMANENT MAGNET.—By G. Poloni.—In cylindrical steel magnets of 50 cm. in length and 6·5 mm. in thickness, which were repeatedly heated to 250° C., and cooled down to the ordinary temperature, the distribution was found to be altered after the heating. At the distance of 14—15 cm. from the north pole the final value is greater than at 25 cm., both absolutely and in relation to its original state.—*N. Cim.* 1880, p. 103.

A NEW EXPERIMENT ON MAGNETIC ATTRACTION.—By E. Piazzoli.—The author shows that the attraction of elder pith by the magnet as observed by Ader depends probably on the presence of small particles of iron.—*N. Cim.* 1880, p. 100.

IMPROVEMENT IN GALVANIC BATTERIES.—By R. Chapman Anderson. (German Patent, No. 10,174 and *Zeitschrift für Ange. Electricität*, 1880, p. 350).—In an ordinary zinc-carbon element the zinc is placed in contact with solution of sal-ammoniac and the carbon with dilute hydrochloric acid, whilst into the latter liquid is plunged a tube, perforated at its lower part and filled with a mixture of equal parts of bichromate of potash and oxalate of chrome and potash (chromium-potassic oxalate). By immersing the tube to different depths the concentration of the solution and the efficiency of the couple are modified. For elements with one liquid only the last solution is employed. If fumes are given off the surface of the liquid may be covered with a thin pellicle of oil, soot, or wood-charcoal.

THE *Oesterreichische-Ungarische Post* continues to criticise severely the organisation of the telegraphic service in the Austrian empire.

DEFORMATION OF A BENT ELASTIC CONDUCTOR UNDER THE INFLUENCE OF TERRESTRIAL MAGNETISM.—H. Niemoeller.—A thick elastic wire from 1·5 to 2 metres in length, and 1 mm. in thickness, is bent in the middle at a right angle and secured at its ends by means of set screws. If the wire lies in the plane of the magnetic meridian it is deflected when a current is passed through it, and on repeated reversals of the current it begins to oscillate. If the action of the earth is neutralised by means of a magnet, and if a second wire is fixed parallel with the first, the phenomena of attraction and repulsion can be demonstrated in either.—*Wiedemann's Beiblätter.*

GRAPHIC INVESTIGATIONS ON GALVANOMETER COILS WITH REFERENCE TO THE GREATEST POSSIBLE SENSITIVENESS.—M. Th. Edelmann.—The author considers galvanometers with circular windings. If the radius of a winding is r, and its distance from the middle of the needle, e, then, since its resistance is proportional to its radius, it follows that the indication on the scale produced by a given electromotive force will be

$$g = \frac{2\pi r}{(e^2 + r^2)^{\frac{3}{2}}}$$

If for a given constant, e, the r are plotted out as abscissæ, and the e as ordinates, the corresponding curve shows the efficacy of the single windings. If the curves obtained for the different e are cut by lines parallel to the axis of the abscissæ, we find the windings of equal value.—*Carl's Repertorium*, 16, p. 670.

IRIDIUM FOR ELECTRIC LIGHTS.—The latest material offered for an incombustible "burner" for the electric light is iridium. Mr. Holland, gold pen maker, of Cincinnati, claims to have discovered a flux by means of which he is able to fuse iridium in an ordinary draught furnace. He casts the metal in any shade desired, and in bars or ingots weighing as much as ten ounces. The metal thus fused and cast defies the file and resists all acids. The only mechanical way of cutting it is by friction with a copper wheel charged with diamond dust or fine corundum. Mr. Holland claims, further, that the cast iridium makes suitable "burners" for the electric light, and that so used the metal is durable without protection from the atmosphere.—*Scientific American.*

THE Commissariat-General of the Paris International Exhibition of Electricity are anxious that all requests for space be sent in as soon as possible, and not later than March 31st.

SOCIETY OF ARTS.—The series of Cantor Lectures, being delivered before the Society of Arts by Professor W. G. Adams, F.R.S., on "The Scientific Principles involved in Electric Lighting," commenced on Monday, the 7th March, and will continue on the three following Mondays, ending March 28th. The first two lectures will be mainly introductory, and will deal with such subjects as the production, regulation, and measurement of electric currents, and the action of magneto-electric and dynamo-electric machines. In the third and fourth lectures it is hoped to show a large number of illustrations of the various systems of electric lighting. The new incandescent lights of Swan and Lane Fox will be exhibited at the fourth lecture.

THE postal telegraph department have issued their accounts, from which it appears that during the past year a profit of £354,030 has been realised, which is equivalent to a dividend of 3·36 per cent.

AT the Electrical Exhibition the Publishers' Union, under the direction of MM. Hachette, will establish an exhibition of electrical publications, and a reading-room, into which will be admitted all the scientific papers of the world, irrespective of their language.

GENERAL ANSON STAGER, vice-president of the American Western Union Telegraph Company, has resigned his office.

A SERIES of "Notes and Queries on Electricity and Electro-magnetism and their Applications," by Mr. T. D. Lockwood, are being published in an American contemporary, *The Operator*. The articles are good of their kind, but a very free use appears to be made of a

well-known English work on electrical testing, in working them up.

EDISON has just been beaten in the Patent Office, in the suit regarding the invention of the Edison as against the Maxim electric light, both of which are similar. The Examiner of Interferences has decided that Edison was not the first inventor, and that the patent must be issued to the United States Electric Lighting Company, representing the Maxim claims. This is the famous platinum lamp, which created such a panic in gas stocks about two years ago, and sent the stock of the Edison Company up to an almost fabulous figure. It is claimed by the United States Company that other important contests relating to incandescent lighting will now be decided in its favour, as it was the first in the field in this country.—*Operator.*

MANY physical treatises still assert that moist air conducts electricity, though Silberman and others have proved the contrary. An interesting experiment bearing on this has been described lately by Prof. Marangoni. Over a flame is heated some water in a glass jar, through the stopper of which passes a bent tube to bell-jar (held obliquely), which thus gets filled with aqueous vapour. The upper half of a thin Leyden jar charged is brought into the bell-jar, and held there four or five seconds; it is then found entirely discharged. That the real cause of this, however, is condensation of the vapour on the part of the glass that is not coated with tinfoil (the liquid layer acting by conduction) can be proved; for if that part of the jar be passed several times rapidly through the flame, so as to heat it to near 100° C., before inserting in the bell-jar, a different effect will be had; the Leyden jar will give out long sparks after withdrawal. This is because the glass being heated no longer condenses the vapour on its surface, and there is no superficial conduction, as in the previous case.—*English Mechanic.*

PORTABLE BATTERY FOR ELECTRO-MEDICAL USES.—W. E. Klein, of Stuttgart, has designed a new battery for such purposes. The elements consist of slips of zinc and rods of carbon. The exciting fluid consists of 300 parts water, 45 chemically pure sulphuric acid, 20 bichromate of potash and 2 persulphate of mercury. In this liquid the zinc slips remain permanently amalgamated, but after use they should be at once lifted out, which is very easily effected by means of screws. The management of the apparatus is exceedingly simple, and failure of action is impossible. Such batteries are fitted up with 10, 14, 20, or 32 elements.—*Zeitschrift Angewandt Electric.*

CURIOUS PROCESS.—The Hamburg-Heligoland telegraph line was entangled with the anchor of a ship in August, 1880, in the latitude of Neuwerk, and cut by order of the captain. An action for damages brought by the company against the owners of the ship has been decided in favour of the defendants. The company has appealed to a superior court.—*Oesterr.-Ungar. Post.*

ELECTRIC FIRE ALARMS.—If self-acting fire alarms are to afford really any protection, they must be distributed in sufficient numbers in the premises to be secured. To render this possible it is again necessary that the apparatus, though perfectly trustworthy, should still be cheap. For this purpose, thermometers, in the strict sense of the word, have been abandoned in favour of thermoscopes. The latter are generally arranged as follows:—A spring or a weight tends to produce electric contact, but is opposed by the solidity of a thermoscopic substance. On the approximation to a temperature of which warning is to be given, the substance melts or softens, gives way, and electric contact is effected with more or less completeness. By means of a suitable selection of thermoscopic substances the temperature which effects contact can be adapted to individual cases. On this principle depend the instruments of Bréguet, Fein, and Dupré. In every such apparatus it is of the greatest importance that the contact should be perfectly trustworthy. In this respect a fire alarm constructed some years ago by Dr. Heeren, of Hanover, seems to us very remarkable. The arrangement of the apparatus is essentially as follows:—An iron hook, turned upwards at a right angle, is fixed in the wall of the room to be protected. Upon it is fixed a perforated disc of rubber, which bears a disc of lead, also perforated, and to which a copper wire is soldered. A weight of 1 to 2 kilos., also perforated in the middle, is fixed on the rod. The weight has below a gilded point, and is lifted up so high by means of a thread that the gilt point is at the distance of 15 cm. from the leaden disc. At the end of the thread is a ring made of Wood's fusible alloy, and hung on a nail. As soon as the dangerous temperature is reached the ring gives way, and the weight drives its gilded point forcibly into the leaden disc, thus effecting a perfect contact. The apparatus, which is sold for 1s. 6d., was shown in 1878 at the Hanover Trade Exhibition. The Hanover "Rubber-card Company" uses a number of these instruments with the best results.—*Zeitschrift Angewandt Elect.*

ON THE DANGER OF LIGHTNING FROM TELEPHONE CONNECTIONS.—The Cantonal Government of Zürich, having been applied to by a telephone company for permission to fix the supports of insulators on the tops of certain public buildings, applied to Prof. Kleiner for an opinion. The following is a summary of the chief points in his report:—

1. The danger of lightning in houses over which telephone wires are stretched is not increased but lessened if the total conductivity of a wire is approximately equal to that of a lightning-conductor. This condition is not always fulfilled under existing arrangements. It may be insured by very simple arrangements, such as the introduction of a special wire for the conduction of lightning wherever the number of wires of two millimetres in thickness running in the same direction is less than 60. This should be insisted upon in all cases. Single connections running along the houses should be stronger than at present—at least as strong as telegraph wires.

2. As the properties of a telephonic plexus for attracting and conducting lightning extend over far wider tracts than those of a lightning rod, a strict regulation of their make and condition is necessary.

The use of telephones should be suspended during thunder-storms.—*Neue Zurich Zeitung.*

DR. UELSMANN'S ZINC-IRON BATTERY.—The batteries hitherto used for the production of powerful galvanic currents are the zinc-platinum, the zinc-carbon, and the zinc-iron. Each of these has its peculiar advantages and defects, and the electromotor forces of the three differ but little. In published accounts we find very notable discrepancies, which are readily explained by the circumstances that the experimentalists did not construct their batteries of perfectly pure materials, that they employed acids of different strengths, and measured the resulting forces by different methods. The application of the zinc-platinum battery is restricted chiefly by the high price of platinum. The zinc-carbon battery is cheaper, and is still much used

in the form designed by Deleuil, with zinc cylinders and prisms of carbon. It is preferable to press the copper vanes which are soldered to the zinc cylinders by means of iron clamps. The contact with the carbon is injured by the nitric acid rising up through the porous mass, hence it is necessary to take out the brittle carbons and free them from acid by steeping in water. The zinc-iron battery, which is still cheaper, is free from these evils. Still it has a bad property, the consequences of which cannot always be got over in regular working. In consequence of the continued liberation of hydrogen at the iron electrode the concentration of the nitric acid gradually decreases, and a point is finally reached when the iron is stripped of its protective layer of oxide, and is dissolved with strong effervescence. The nitric acid then passes into the glass cells, and the battery must at once be taken to pieces—an unpleasant task—large volumes of suffocating hyponitrous gas are evolved. Although the first cost of the zinc-iron battery is smaller than that of the others, the zinc-carbon battery is often preferred on account of the inconvenience just mentioned. Dr. Uelsmann's invention completely overcomes this difficulty. By adding silicon to the cast-iron he prevents the iron electrodes from being suddenly thrown into the active or soluble state. As might have been assumed, an experimental examination has shown that this addition of silicon has no perceptible effect on the electric properties of the electrodes, and 10 per cent. more of the acid is capable of being utilised. The danger of boiling over is completely avoided. The silico-iron electrode is therefore a notable step in the construction of hydro-galvanic batteries.—*Zeitschrift Angewandt Electr.*

ELECTRIC LIGHTING IN THE CITY.—At a meeting on March 8th of the City Commissioners of Sewers at Guildhall, at which Mr. Ashby presided, the Streets Committee reported that the Electric and Magnetic Company (Jablochkoff's system) had expressed their regret that in consequence of legal and other difficulties they were not in a position to seal the contract for the electric lighting of a portion of the City, in accordance with their tender of the 20th October last. The Committee had consequently made arrangements with the Electric Lighting and Power Generation Company (Lontin System) to light the district in question for a year at the same cost, £2,930. The district includes Southwark Bridge, Queen Victoria-street, Queen-street, and Queen-street-place. As far as this district was concerned, the experiment would be delayed a month, commencing May 1st. The other two districts to be lit by the Siemens and Brush system would be commenced on May 1st. The report was carried.

JOHNSON'S PATENT TRANSMITTER.—We are informed that this instrument, in combination with Bell's receiver, is at work at Sheffield on the Telephone Exchange, and on long private wires, and is giving the greatest satisfaction. No adjustment is required, and the tone is exceptionally loud and clear.

THE Annual report of the American Commissioner of Patents for the year ending December 31, 1880, gives the business of the year as follows:—Applications for patents for inventions, 21,761; applications for patents for designs, 634; applications for reissues of patents, 617; total, 23,012. Patents issued, 13,441; patents reissued, 506; patents expired, 3,781; trade-marks and labels registered, 533. Of the 13,441 patents issued during the year, 12,655 were to citizens of the United States, and 786 to foreigners. There was received during the year for patents, copies of records or drawings, and from other sources, an aggregate of $749,685.32. The total amount expended was $538,865.17, leaving a balance of $210,820.15. On January 1, 1880, there remained $1,420,806.56 to the credit of the Patent Fund, which, added to the surplus of 1880, makes the amount to the credit of the Patent Fund on January 1, 1881, $1,631,626.71.

THE Paris Exhibition of Electricity will contain a number of curiosities. M. Salignac will present to the Director-General a plan for cooking by electricity in the grill-room of the restaurant. This plan should provide useful work during the day for the magneto-electric machinery, and test its warming power. M. Michels, an American residing in Paris, has patented a revolving carbon which can be rolled like an ordinary conductor.—*Nature.*

M. MARCEL DESPREZ has been created a Knight of the Order of the Legion of Honour.

IT is stated that Mr. Silbiger has contracted for the construction of an electric railway between Shipping Point and the camp at Aden.

ACCORDING to the *Bulletino Telegrafico* there has been put up for experiment in the Central Office at Rome a Hughes machine with a Humblot hydraulic motor.

ELECTRIC HOIST BY SIEMENS AND HALSKE.—The transfer of power by the means of the dynamo-electric machine has met with a new application in an elevator for persons exhibited at Mannheim, by Siemens and Halske, in which electric force is substituted for hydraulic force or for the action of a rope. The hoist serves in the Industrial Exhibition of Mannheim to raise visitors to a balcony of the height of about twenty metres, and in the course of a few weeks has been made use of without inconvenience by about 8,000 persons, with a speed of about fifty centimetres per minute. The arm of a lever within reach of the hand of a person standing on the platform, renders it possible to change at will the direction of the movement by turning the arm to the right or the left. If the lever is held in the intermediate position the current is interrupted and the movement is stopped. The commutator acts automatically at the two extreme points of the journey.—*Telegrafista.*

APPLICATION OF ELECTRICITY TO WIND UP CLOCKS.—A watchmaker of Copenhagen, L. Sonderburg, has constructed a clock which is said to wind itself up by the aid of an electric current. According to the *Wiener Allgemeine Zeitung*, the spring of the clock is kept constantly wound up by means of an electro-magnet. This magnet, therefore, has the duty of superseding the periodical winding-up of the spring or the weight. The idea is not novel, as a similar application of electricity has been already tried with advantage in certain forms of telegraph apparatus in order to dispense with the trouble of winding up the motor (spring or weight) every few minutes. A watch on this principle will require a somewhat strong battery, which adds to its cost without rendering it more trustworthy as a timekeeper or improving its appearance.—*Oesterreichische-Ungarische Post.*

THE Glasgow Town Council have accepted the offer of the Crompton Lighting Company, Limited, to light, for their inspection, George Square, by means of two large electric lights, for one week free of charge. If the light is deemed satisfactory the company offer to light the square for three or six months at the respective rates of £60 or £120.

New Patents—1881.

539. "Electric lamps." E. G. BREWER. (Communicated by T. A. Edison.) Dated February 8.

542. "Telephonic apparatus." J. SAX. Dated February 8.

562. "Improvements in carbon burners for incandescent conductors for electric lamps, and in the means and methods of manufacture and treatment thereof, partly applicable to the manufacture of other carbon articles." P. JENSEN. (Communicated by T. A. Edison.) Dated February 9.

579. "Electro photographical receivers for telegraphs." H. CHAMEROY. Dated February 10.

607. "Improvements in apparatus employed for and in telegraphic or telephonic communication." P. M. JUSTICE. (Communicated by J. V. M. Bartelons.) Dated February 11.

639. "An improved process or method of preparing carbon and other conductors to be used for electric lighting and other purposes." W. R. LAKE. (Communicated by H. S. Maxim.) Dated February 15.

663. "Telephonic apparatus and signals therefor." P. M. JUSTICE. (Communicated by H. R. Miller.) Dated February 16.

667. "Railway point and signal apparatus." J. SAXBY and J. S. FARMER. Dated February 16.

715. "Improvements in and connected with electric lamps, parts of which are applicable for other lighting and heating purposes." J. G. TONGUE. (Communicated by A. Lacomme.) Dated February 18.

732. "A magnetic fire annihilator." W. WALKER. Dated February 21.

760. "Telephones." E. W. ANDERSON. (Communicated by J. Goodman.) Dated February 23.

768. "Connecting the ends of the carbon to the conducting wires in electric lamps." E. G. BREWER. (Communicated by T. A. Edison.) Dated February 28.

774. "Electric lamps." J. FYFE. Dated February 23.

783. "Improvements in electrical conductors applicable to electric railways, and to electric signalling and in apparatus connected therewith." J. PERRY and W. E. AYRTON. Dated February 24.

785. "An improved method of covering wire for electrical purposes, and in the orderly arrangement of multiple electrical conductors." W. E. AYRTON. Dated February 24.

792. "Improvements in electric lamps, and in circuits for the same." P. JENSEN. (Communicated by T. A. EDISON.) Dated February 24.

803. "Improvements in dynamic apparatus and motors, in batteries in connection therewith, and in carbons for obtaining electric light." R. WALLER. Dated February 25.

843. "Cards and magnetic needles for mariners' compasses." H. J. HADDAN. (Communicated by J. Lewis and F. A. Brown.) Dated February 28.

844. "Galvanic batteries." F. WIRTH. (Communicated by E. M. Reiniger.) Dated February 28.

859. "Apparatus used in erecting and repairing overhead telegraph wires." J. W. FLETCHER. Dated March 1.

879. "Improvements in electric light signalling, and means or apparatus connected therewith." A. SHIPPEY. Dated March 1.

894. "Electric lamps." J. J. SACHS. Dated March 2.

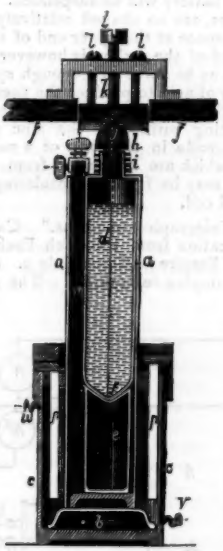
913. "Improvements in machinery for twisting and lapping wires and other materials in the manufacture of ropes or cables; for insulating and covering telegraph wires, and for other analogous purposes." W. T. GLOVER and G. F. JAMES. Dated March 3.

918. "Method and apparatus for producing audible signals on railways by electricity." E. TYER. Dated March 3.

925. "Telephone transmitters." C. MOSELY. Dated March 4.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1880.

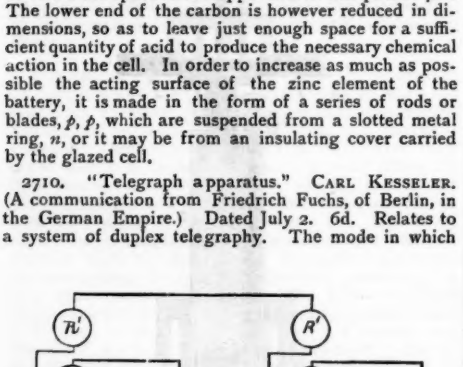
2597. "Electric batteries." A. V. NEWTON. (A communication from abroad by Ferdinand Tommasi, of Paris.) Dated June 25. 6d. Relates to batteries in which two exciting liquids are employed, the chief object being to provide a continuous supply of acid to the porous pots, and also to insure the cutting off of this supply from all the pots of the battery simultaneously. The figure is a vertical section of a single cell battery. *a* is the porous pot, which rests upon a support of earthenware or glass, *b*, contained in a glazed outer cell, *c*.



The porous pot is made about double the depth of the outer cell, and is fitted with a glass stand for receiving a stoppered vessel or phial, *d*, for containing the nitric or other acid intended to be supplied to the porous pot. This vessel is semi-cylindrical, and it is formed with a conical bottom in order to fit a conical recess made in the stand, *e*. The stand, *e*, is of similar shape, but is somewhat smaller in cross section than the vessel, *d*, in order to provide space for the reception of a sufficient quantity of acid to insure the proper action of the battery. At the bottom of the glass vessel, *d*, is a small opening, *f*, for the discharge of the acid, and the vessel is so situate that this opening will be at about the level of the exciting liquid in the outer glazed cell

c. This arrangement provides against the reserve of acid contained in the vessel, *d*, mixing with the partially exhausted acid in the porous pot, and allows of the acid in the porous pot being maintained at any desired level. The glass vessel is fitted at its upper end or neck with a loose glass stopper, *g*, under the flange of which is placed an india-rubber washer, *h*, that will seal the opening and prevent the admission of air to the vessel, *d*. A coiled spring, *i*, surrounding the neck of the vessel and bearing on the under side of the stopper serves to raise the same from its seat and admit air into the vessel, *d*, whereby a discharge of the acid into the porous cell will be effected, the rate of supply being determined by the amount of air admitted. *m* is the carbon contained in the porous pot. To regulate the admission of air to the vessel, *d*, the cells of the battery are arranged in a case, which is provided with a cover, *j*; this cover when closed will overlie the stoppers of all the glass vessels of the battery, and immediately over each stopper a hole is formed in which a loose piece, *k*, is fitted; this loose piece is held in position and can be adjusted relatively to the stoppers by means of the bridge and screws, *l*, *l*, *l*. The cover of the box is hinged, and provided with a regulating screw and winch handle, by which means, through the pressure of the pieces, *k*, on the stoppers, *g*, the quantity of acid supplied to the carbons may be regulated to the greatest nicety or shut off at pleasure. In the latter case the action of the battery will be suspended. The vessel, *d*, and carbon, *m*, are so shaped relatively to each other as to fill the space at the upper end of the porous pot. The lower end of the carbon is however reduced in dimensions, so as to leave just enough space for a sufficient quantity of acid to produce the necessary chemical action in the cell. In order to increase as much as possible the acting surface of the zinc element of the battery, it is made in the form of a series of rods or blades, *p*, *p*, which are suspended from a slotted metal ring, *n*, or it may be from an insulating cover carried by the glazed cell.

2710. "Telegraph apparatus." CARL KESSELER. (A communication from Friedrich Fuchs, of Berlin, in the German Empire.) Dated July 2. 6d. Relates to a system of duplex telegraphy. The mode in which



telegraphing is carried on is as follows:—If the key at station, A, is depressed, the contact screw on the contact lever, *b*, being set properly, the connection between the latter and the contact, *a*, is interrupted at *a*, and the electro-magnet coils of the apparatus separated from each other, that is, the coil, R², is thrown out of circuit. But at the moment the key lever touches the contact screw, *c*, the battery is closed, and the current therefrom passes by *b*, through the coil, R¹, into the line wire. At the station, B, where there is still contact at *a*, the current traverses the two coils of the apparatus, and then goes to earth. When the return spring of the armature is properly regulated, the apparatus at A, where the current only passes through one coil, does not speak, whereas the apparatus at B, where the magnetic influence on the armature is about double that of A, responds. If the key at A and that at B are simultaneously depressed, the coil, R², is thrown out at both stations; but as now the batteries of both stations (which are connected to earth with their poles opposing) send their current into the line wire, and as moreover the coil, R¹, is traversed by a current of double the speaking strength, and hence, the magnetic influence on the armature is as great as when the current from one battery traversed both coils, it follows, therefore, that the apparatus must respond both at A and B. As soon as the key at one station drops into its normal state of rest, the current in the line wire falls to half its strength, and the armature of the apparatus at the other station falls off.

2730. "Automatic electric time signalling apparatus." JASPER WETTER. (A communication from abroad by William H. Shuey, of United States of America.) Dated July 3. 1s. Relates to improvements in automatic electric time signalling apparatus, the object being to combine with any approved time mechanism an electric signalling apparatus which shall be operated by and in unison with the time mechanism, and shall be of such construction and arrangement of parts that it will actuate one or more signals automatically at any predetermined periods of time throughout the twenty-four hours of each day. The invention consists, first, in the combination with a time piece provided with mechanism for breaking an electric circuit at any regular intervals of time of a motor actuated by spring, weight, water, or other power; a wheel furnished with stop pins corresponding in number to the number of minutes in twenty-four hours, said wheel being revolved by the motor; a circuit closing device connected with the signalling devices and adapted to close the circuit at any moment of time indicated on the wheel, the stop pin corresponding to the time of sounding, the signal being withdrawn to allow of the automatic closing of the circuit; an armature connected at one end with the circuit closers and electric magnets located in the circuit embracing the time mechanism, and adapted to regulate the movement of the stop pin wheel and cause the motor connected therewith to impart an intermittent rotary movement thereto, and move it through a space equal to the distance between any two adjacent stop pins, showing each movement of time as indicated by the time mechanism. It further consists in the combination with a wheel or cylinder provided with any desired number of removable stop pins and mechanism for revolving said wheel in unison with a time piece or regulator of two or more circuit closers located in the electric circuit embracing the signals, said circuit closers being arranged to close the circuit at any moment of time during the twenty-four hours of a day by removing the stop pin designating the minute at which it is desired to sound the signal. The invention also consists of a wheel provided with a continuous row of stop pins extending around the wheel any desired number of times in a spiral form or line, of an automatic circuit closer and mechanism for moving said circuit closer transversely across the periphery of the wheel or cylinder.

2764. "Electric lamps." GEORGE GUILLAUME ANDRÉ. Dated July 6. 8d. The objects of the

invention are to regulate the position of the electrodes so that the resistance of the voltaic arc is practically maintained constant. A small electro motor is used to propel the electrodes. The armature of the motor is wound with a double set of wires, so that the armature ring can be made to revolve in the direction of the predominating current whenever the equilibrium between them is destroyed, and in this way the relative position of the electrodes is varied or changed as may be required in order to restore equilibrium in the coils of the ring.

2849. "Signalling apparatus." FREDERIC NEWTON GISBORNE. Dated July 10. 6d. The object of this invention is to provide a signalling apparatus suitable for transmitting messages by visible signals from a shore station to ships at sea, and from one station to another, where the electric telegraph is inadmissible. Symbols are employed representing the ball, flag, and pennant, and these are used either as solid figures in black on a white ground, or white on a black ground, or as transparencies which when illuminated will be visible at night; or the symbols may be painted solid on a transparent ground, and used to throw shadows on an illuminated surface. The signals are turned in position by hand mechanism.

2865. "Synchronising or setting clocks, &c." JOHN ALEXANDER LUND. Dated July 12. 2d. Relates to synchronising clocks by means of an electric current, or by a pneumatic or other time signal, which is sent every hour from a normal or standard clock. The main object being to allow of the clocks being set or corrected from a greater error than has hitherto been attainable with apparatus of this description. A heart piece is used in connection with a stop piece and levers similar to those used in chronograph watches; the stop piece is caused to revolve by the fall of a weighted lever, which releases the minute spring, sets the hands, momentarily detains the hands at correct time, and resets the minute spring, leaving the clock then to go on until the next successive set. (*Provisional only.*)

2888. "Signalling apparatus for mines." H. J. HADDAN. (A communication from abroad by Charles Cummings, of Virginia City, Nevada, United States of America.) Dated July 13. 6d. Relates to an electric signalling apparatus, consisting of a steam whistle operated by an electro-magnet.

2891. "Detecting and indicating stoppages, &c., in telegraphic or pneumatic communications." JOHN ALEXANDER LUND. Dated July 13. 2d. Relates to means or apparatus for detecting and indicating faults in telegraphic or pneumatic communications whereby a visible or audible indication may be given. On any suitable part of the "motion" or train of the time piece two insulated pins are set. One of these pins acts upon one of the contact springs a few minutes before the passage of the testing current which is transmitted, thus bringing the one spring partly towards contact with the other spring, but leaving it held by a catch. The testing current is made to pass through an electro-magnet, the keeper or armature of which is attached to the catch, and therefore as long as the telegraph line is in working order the catch is withdrawn by the passage of the testing current. The spring is therefore released and the second pin passes it without acting on it. But should the communication be broken either in the line tube or instrument, and the testing current fail to pass through, the spring remains held by the catch, and then the second pin acts upon it and brings it into contact with the second spring, so that the circuit through the local battery being complete, the current from this battery passes to the bell alarum, causing the same to sound, and also to the indicator, which will then indicate that the line is broken down.

2980. "Regulators for electric lamps." A. M. CLARK. (A communication from abroad by John Henry Guest, of Brooklyn, United States of America.) Dated July 20. 2d. The object of this invention is to furnish means for automatically regulating the length of the arc in electric lamps, and to prevent fluctuations in the light by changes in intensity of current. The invention consists primarily in a thermoscopic rod combined with an electric lamp for expansion, according to the intensity of the current and resistance in the circuit. The lineal expansion is multiplied by levers, which act by clamps to separate the carbons. The invention also consists in the combination with the expansion rod of a section of carbon or metal of low conductivity, whereby the heat due to resistance is rapidly generated and dissipated; also in a shunt for dividing the current when the carbons are separated to a definite point, and in certain other details of construction which render the action more perfect and adjustable. (*Provisional only.*)

Reviews.

Des Applications du Téléphone et du Microphone à la Physiologie et à la Clinique. Par Dr. M. BOUDET, de Paris. Vve. Frédéric Henry, Rue de l'Ecole de Médecine, Paris.

ALTHOUGH the microphone combined with the telephone at first seemed likely to prove of considerable value to the medical world, yet the success obtained in this direction can hardly be said to have been great; indeed at the present time but little if anything is heard of the new idea.

Amongst the most prominent workers on the subject has been Dr. Boudet, the author of the above work. In a well written book of nearly two hundred pages Dr. Boudet has dealt very fully with the whole matter. As is pointed out in the preface, a great cause of the failure of the microphone-telephone instrument to produce useful results has been the disagreement among physicians as to the exact nature of the sounds produced by the instrument. Unlike the stethescope, the microphone-telephone does not enable sounds produced in the body to be heard plainly, but it merely copies, as it were, those sounds, and sometimes does so very imperfectly.

Since the discovery of the microphone Dr. Boudet has studied the conditions under which the marvellous sensibility of the apparatus can be utilised, and the results are given in his work. The first part of the book describes the receiving apparatus, the ordinary Bell telephone, pointing out the construction and action of the latter. The transmitters, which are alluded to next, are divided into two classes, viz., those which produce complete interruptions of the current, and those which vary the latter. These descriptions, for the kind of book, are very full, almost unnecessarily so. In the chapters dealing more directly with the general subject of the work, muscular action, the circulation of the blood, affections of the throat and of the heart, &c., are diagnosed by means of the microphone-telephone,

and with good results. Particular forms of the microphone have been designed for these purposes, which are described and illustrated. In conclusion Dr. Boudet states that the microphone-telephone is likely to prove a valuable auxiliary to the faculty.

Questions on Magnetism and Electricity. By F. W. LEVANDER, F.R.A.S. H. K. Lewis, Gower Street, London.

THIS little book contains solutions of questions in magnetism and electricity set at the preliminary scientific and first B. Sc. examinations of the University of London from 1860 to 1879, together with definitions, dimensions of units, miscellaneous examples, &c. There can be no doubt but that a book of the kind is very useful to students preparing for examinations. Mere questions are not enough, as, of course, the learner has no certain means of verifying the correctness of his answers. In Mr. Levander's work the replies to the various questions are given in a clear and brief manner, just in the way in fact in which the answers should be given at an examination.

Telegraphic Tales and Telegraphic History. By W. J. JOHNSTON, Murray Street, New York.

THE main portion of this book is taken up with a collection of stories and anecdotes with which telegraphic history is very rich; but although the reader will find very much to entertain and amuse him, yet he will also find a large amount of interesting information given. The work is certainly worth perusing, and it deserves a good sale.

Books Received.

La Telectroscope. Par M. SENLECQ D'ARDRES. Paris: 38, Rue de la Sourdière; London: 29, Bedford Street, Strand.

Electro-Typing. By J. W. URQUHART. Crosby Lockwood & Co.

Electricity. By FLEEMING JENKIN, F.R.S. Society for Promoting Christian Knowledge, London.

Proceedings of Societies.

PHYSICAL SOCIETY.—FEBRUARY 26th.

Prof. FULLER in the Chair.

THE former resolution regarding the moneys of the Society for investment was adopted.

Dr. O. J. LODGE exhibited a hydro-mechanical apparatus illustrating the fact that conductors of electricity are opaque to light, and showed by means of a Wheatstone's photometer (which combines two circular motions into a harmonic one), how the plane of polarisation of a beam of light passing through a magnetic medium is rotated.

Mr. C. V. BOYS exhibited his new integrating machine, which is the only one illustrative of the mathematical process of integration, and is therefore specially valuable for teaching purposes.

Mr. SHELFORD BIDWELL read a paper on the telegraphic transmission of pictures of natural objects. The process is explained as follows:—The positive pole of a battery is connected through a set of resistance coils to a piece of platinum wire, and the negative pole to a plate of zinc, upon which is placed a sheet of paper moistened with a solution of potassium iodide. The negative pole of a second battery is connected through a selenium cell with the same platinum wire, and the positive pole to the zinc plate. The point of the platinum wire is pressed upon the paper, and the selenium being exposed to a strong light, the variable resistance is so adjusted that the currents from the two batteries, which pass through the paper in opposite directions, exactly neutralise each other. The platinum point will now make no mark when drawn over the paper; but if the selenium is shaded, its resistance is immediately increased: the current from the first battery then predominates, and the path of the platinum point across the paper is marked by a brown line, due to the liberation of iodine. The line is fainter the feebler the light is. [This arrangement has been applied by Mr. Bidwell in his "tele-photograph," exhibited to the meeting.] The transmitter consists of a brass cylinder, mounted on a screw spindle, which carries the cylinder laterally $\frac{1}{24}$ inch at each revolution. A pinhole in the middle of the cylinder allows light to fall upon a selenium cell placed behind it within the hollow cylinder. The cell is connected in circuit with a battery and the line. The receiver consists of a similar metal cylinder, mounted so as to rotate synchronously with the first, and having a platinum point pressing upon a sheet of chemical paper wrapped round the cylinder. This receiver and transmitter are connected up, as described above, with two batteries and a set of resistance coils. The image to be transmitted is focussed upon the cylinder of the transmitter, and the resistance adjusted, and the receiving cylinder covered with sensitised paper. The two cylinders are caused to rotate synchronously; the pinhole, in the course of its spiral path, covering successively every point of the focussed picture. The amount of light falling upon the selenium will be proportional to the illumination of that particular spot of the projected image which is for the time being occupied by the pinhole, and the intensity of the line traced by the platinum point in the receiver will vary in the same proportion. These variations will produce a picture which, if the instrument were perfect, would be a counterpart of that projected upon the transmitter. Simple designs cut out of tin-foil, and projected by a lantern, have been successfully transmitted. With selenium, and paper of greater sensitiveness, more perfect results might undoubtedly be obtained.*

Professors AYRTON and PERRY showed an experiment illustrating their plan for sending light and shade images by electricity. A selenium cell was connected in circuit with a battery and a coil of wire, surrounding a tube, along which a beam of light passed. A shutter, having a small magnet attached, was suspended in the tube like a galvanometer mirror, so that when a current traversed the coils the shutter was deflected, so as to close or partially close the tube and shut off the beam of light. It will be understood that when a ray of light fell on the cell, and diminished its resistance, the current in the coils would increase to a degree proportional to the intensity of the ray, and thus the shutter would

* For illustrated description of this apparatus see page 82 of last issue.

proportionally cut off the light in the receiver. If, now, a number of these elementary circuits were combined, so as to provided a mosaic of cells to transmit the reflected image of an object, and a screen to receive the corresponding beams of light, controlled by the shutters at the other end of the line, there would be a means of sending light and shade images by wire. A rapidly rotating arm, carrying a row of cells upon it, might answer for a stationary mosaic transmitter, and need fewer cells; while a Japanese mirror, having its curvature altered by electro-magnets behind, might be made to act as a receiver; the "magic" images of that mirror being due to inequalities of curvature.

Professor AYRTON agreed with Mr. Bidwell in his conclusion that selenium cells of high resistance were more sensitive to light than cells of low resistance.

Dr. COFFIN suggested that Mr. Bidwell should adopt other than the cylindrical form of receiver, and move an image of the object across the pinhole.

Professor G. C. FOSTER advised bringing the light always on one and the same part of the selenium cell.

THE SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS.

AN ordinary general meeting of this Society was held on Thursday, February 24th, Professor CAREY FOSTER, President, in the chair. The minutes of the last general meeting having been read and confirmed, and the list of new and proposed members read, the discussion on Mr. Alexander J. S. Adams' paper on "Earth currents and electric tides" was concluded.

Mr. WILLOUGHBY SMITH gave some further particulars with reference to his experiments on wires laid across the Thames.

Mr. A. J. S. ADAMS, in replying, said that with reference to solar and lunar variation, it was difficult to separate the two influences, as the two were merged together; the same was the case with reference to the connection between the magnetic variation and the earth currents. In comparing the earth current curves it was advisable to make the comparison with solar and lunar variation rather than with the time of high water. He pointed out that some curves, plotted out from observations taken in Persia, agreed with his theory. Some experiments made by Mr. Graves at Valentia, on a piece of cable 560 miles long, showed similar results; and as, in this case, but a very small portion was subjected to tidal influence, this was a proof against the theory that the currents were due to the flow of tidal water. The curves obtained at Valentia showed a lagging of one hour behind the moon's changes, which agreed with his own observations. Some experiments, made in 1868, on one of the Irish cables, showed that currents existed which followed the rise and fall of the tide, and varied with the beat of the waves. The currents from the flow of a river under wires, he considered, would be too weak to be appreciable. He thought that currents could not be due to differences of potential at different parts of the earth's surface, as the longer the line the stronger ought to be the current, which was not the case.

Lieutenant CARDEW, R.E., said that he had observed powerful earth currents on a bare wire, fifteen miles long, laid on the ground; this occurred as a storm passed over it.

A paper was then read by Lieutenant CARDEW, R.E., on "The application of dynamo-electric machines to railway rolling-stock." It was proposed to attach a dynamo machine to the axle of the driving-wheel of the locomotive of the train, and to pass the current generated through dynamo machines connected to the wheels of the carriages, these wheels would then be rotated by the current, and would give a more uniform motion than would be the case when the engine alone drew the train. By changing the connections, the current could be made to retard the motion of the wheels of the carriages, as thus to act as a brake.

Mr. ALEXANDER SIEMENS, Mr. C. E. SPAGNOLETTI, and Mr. G. K. WINTER doubted the practicability of the scheme.

Mr. R. E. CROMPTON thought the difficulties in adapting the scheme were by no means so great as the latter gentlemen seemed to think. He thought it a remarkable thing that no decided attempt had been made to design a dynamo machine brake by attaching a dynamo to the axles of the carriages, and then simply closing the circuit of the machine when a brake action was required. The way in which the short-circuiting of a dynamo machine "drew up" the driving-engine was remarkable.

Mr. KEMPE pointed out that with a dynamo-electric brake the action would become less and less as the train was drawn up.

Professor AYRTON said that this would be a positive advantage, as the experiments of Col. Galton, for the Board of Trade, had shown.

Mr. EDWARD B. BRIGHT then read a paper on "The interference with the processes of manufacture of wool and hair, arising from the development of electricity during spinning." It was found in spinning factories that the fibres of the material used had a tendency to cling to parts of the machine when the process of spinning was being carried on, so much was this the case that in some climates it was found impossible to work except at certain seasons of the year. To get rid of this effect it was the custom to place the wooden bobbins full of the half manufactured material in a damp cellar, and to keep them there for a considerable period before remanufacture. The cause of the clinging action was found to be due to electricity, and it was at first thought that putting the machinery to earth would get over the difficulty, but this only tended to aggravate it. Finally it occurred to the author that electricity could discharge itself readily in a partial vacuum. Accordingly the bobbins were placed in an iron chamber partially exhausted of air; this device was completely successful, and bobbins which formerly required several months to discharge could be discharged in as many minutes.

Mr. PREECE said that the peculiar effect had first been assigned to electrical action by Mr. Gilpin, the clerk of Mr. Bright; the latter gentleman had discovered the method of getting rid of the electricity by a device which answered very perfectly.

After some remarks by the President the meeting adjourned, votes of thanks having been proposed and carried.

City Notes.

Old Broad Street, March 11, 1881.

DIRECT UNITED STATES CABLE COMPANY, LIMITED.—The seventh ordinary general meeting of the above Company was held on February 25th at the City Terminus Hotel, under the presidency of Mr. J. Pender, M.P. The chairman, in moving the adoption of the report (see TELEGRAPHIC JOURNAL, last issue), referred to the completion of the arrangements respecting the agreement between the Anglo-American, the

Direct United States Cable Company, and the French Company. Alluding to the report, he went through the figures given relating to the working of the half-year, which he said had been of a very satisfactory nature. The reduction in the revenue was attributable to the low competitive tariffs which had been in force for a portion of the half-year. It was hoped that the reduction of the tariff from 3s. to 2s. a word would be appreciated by the telegraphing public, and result in benefit to the Company. He had intended to go somewhat into details as to the condition and prospects of Atlantic telegraphy generally, but circumstances had arisen which for the present had given rise to litigation, and it would be injudicious for him to say anything which could prejudice the case one way or the other. They were narrowly watching the interests of the proprietors, and they looked forward hopefully to the future. Mr. W. Ford seconded the motion, which was at once unanimously adopted, and a vote of thanks to the chairman and directors closed the proceedings.

TELEGRAPH CONSTRUCTION AND MAINTENANCE COMPANY.—The annual meeting of this Company was held on the 1st inst. at the Cannon Street Hotel. The chairman, Sir Daniel Gooch, Bart., M.P., in moving the adoption of the report (given in our previous issue), stated that during 1880 the Company's operations comprised the completion of the Eastern Extension Telegraph's duplicate Australian cable, and the laying of cables connecting the Northern and Middle Islands of New Zealand; between the Island of Luzon (Manilla) and Hong Kong; and connecting Newbiggin, on the east coast of England, with Arendal, in Norway, and Arendal with Marstand, on the coast of Sweden. The total length of cables laid during the year was 3,453 miles. The shareholders must feel satisfied at the completion before the commencement of 1880 of the Cape cable, and at the important part which the Company had taken in the work. They and the Eastern Company were the only parties who originally found money to lay the cable; and it was with great difficulty that they had obtained help from the Government. The Government ought to congratulate themselves and the Company upon having had the use of that cable during the last twelve months, and more particularly during the last few days. The news which had been recently communicated from the Cape had undoubtedly been very sad, but it had come in a way which must be very useful to the Government departments. The Company had chartered one of their ships—the *Calabria*—to carry troops to the Cape. She sailed from Kingstown on Sunday last, and her fittings and equipment were entirely to the satisfaction of the Government superintendents. In reply to Mr. W. Abbott, the chairman stated that the Company would do all they could to secure orders for laying cables for electric lighting. He had seen those at present in use. They were of a very rough character, being simply wire covered with tarred hemp, and there was great room for improvement. Sir Daniel Gooch then moved the adoption of the report and the declaration of the dividend. Sir George Elliot, Bart., seconded the motion, which was carried.

MONTEVIDEAN AND BRAZILIAN TELEGRAPH COMPANY, LIMITED.—The annual general meeting of the shareholders in this Company was held on March 10th at the offices, King's Arm's-yard, Moorgate-street, under the presidency of Sir T. G. Browne. The report stated that the Company's percentage of the gross earnings of the Western and Brazilian Company amounted, for the year ending the 31st of December last, to £3,256, the December quarter being estimated at £850. After setting aside £500 for redemption of debentures and providing for all charges and debenture interest accruing during the year, there remained a net balance of £1,491, out of which it was proposed to pay a dividend of 3s. per share, being £1 10s. per cent., and to carry forward £244 to the next account. The balance-sheet showed that £2,250 of the debentures had been redeemed, leaving £13,830 still outstanding. The chairman formally moved the adoption of the report: and the motion, having been seconded by Lieut.-Col. G. W. Macauley, it was carried unanimously. The dividend was next declared on the motion of the chairman, seconded by Mr. C. Cameron, M.P.; and the retiring directors, Sir T. G. Browne, and the auditor, Mr. W. S. Ogle, having been re-elected, the meeting terminated.

THE Brazilian Submarine Telegraph Company, Limited, have declared an interim dividend of 3s. 6d. per share, free of income-tax.

THE India Rubber, Gutta Percha, and Telegraph Works Company, Limited, notify that with reference to the Mexican Telegraph Company's cable, a further telegram has been received announcing the completion of the section from Tampico to Vera Cruz, thus placing the latter in connection with the American land lines.

THE estimated traffic receipts of the Anglo-American Telegraph Company for the month of January are £48,550, against £67,980 for January, 1880; and for the month of February are £49,180, against £40,830 for February, 1880. Those of the Direct United States Cable Company for January last are £16,180, and for February £16,390. It must be borne in mind that the tariff of the Anglo Company last year at this time was 3s., whereas it is now but 2s. per word.

The following are the final quotations of telegraphs:—Anglo-American, Limited, 58-58½; Ditto, Preferred, 86-86½; Ditto, Deferred, 30-30½; Black Sea, Limited, ——; Brazilian Submarine, Limited, 10-10½; Cuba, Limited, 8¾-9¼; Cuba, Limited, 10 per cent. Preference, 16½-16¾; Direct Spanish, Limited, 3⅞-4; Direct Spanish, 10 per cent. Preference, 13-13½; Direct United States Cable, Limited, 1877, 10¾-11; Scrip of Debentures, 101-103; Eastern, Limited, 9¼-9¾; Eastern 6 per cent. Preference, 12½-12¾; Eastern, 6 per cent. Debentures, repayable October, 1883, 104-107; Eastern 5 per cent. Debentures, repayable August, 1887, 101-103; Eastern, 5 per cent., repayable Aug., 1899, 102-105; Eastern Extension, Australasian and China, Limited, 9¼-10⅛; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 108-111; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, 104-106; Ditto, registered, repayable 1900, 104-106; Ditto, 5 per cent. Debenture, 1890, 102-104; Eastern and South African, Limited, 5 per cent. Mortgage Debentures, redeemable 1900, 101-103; Ditto, ditto, to bearer, 102-104; German Union Telegraph and Trust, 10-10⅜; Globe Telegraph and Trust, Limited, 6⅛-6⅜; Globe, 6 per cent. Preference, 12-12½; Great Northern, 11⅛-11⅜; 5 per cent. Debentures, 102-105; Indo-European, Limited, 26-27; London Platino-Brazilian, Limited, 5⅛-6⅛; Mediterranean Extension, Limited, 2¼-3; Mediterranean Extension, 8 per cent. Preference, 10-10⅛; Reuter's Limited, 10⅞-11¼; Submarine, 270-290; Submarine Scrip, 2⅜-2⅝; Submarine Cables Trust, 99-102; United Telephone Company, ——; West Coast of America, Limited, 4⅜-4⅝; West India and Panama, Limited, 1⅛-1¼; Ditto, 6 per cent. First Preference, 6¼-6½; Ditto, ditto, Second Preference, 5⅛-5⅜; Western and Brazilian, Limited, 7⅛-7⅜; Ditto, 6 per cent. Debentures "A," 103-107; Ditto, ditto, ditto, "B," 98-102; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 122-127; Ditto, 6 per cent. Sterling Bonds, 101-104; Telegraph Construction and Maintenance, Limited, 35¼-36; Ditto, 6 per cent. Bonds, 105-108; Ditto, Second Bonus Trust Certificates, 3⅛-3⅜; India Rubber Company, 18¼-19; Ditto, 6 per cent. Debenture, 103-106.